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IN THIS ISSUE

KNIGHT ON SELENIUM IN SOILS—ITS RELATION
TO PUBLIC HEALTH

SHEPARD ON SCIENTIFIC PLANNING FOR CITIES

WHITE ON EDUCATION AND THE PRESENT CRISIS

CIRCULATION THIS ISSUE OVER 15,000

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SELENIUM

AND ITS RELATION TO SOILS, PLANTS, ANIMALS, AND PUBLIC HEALTH*

HENRY G. KNIGHT

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Mr. Chairman: The intensive research on the chemical elements in soils, particularly soils adapted to agricultural purposes, indicates the need for more specific information. We have come to the realization that our knowledge, great as it is, is far too meager for adequate application. For example, we know that some soils are peculiarly adapted to corn, others to cotton, fruits, vegetables, pasture, and so on, but we have inadequate information concerning the part that chemical elements play in the production of plants that grow on these soils.

There is every indication that the bluegrass region of Kentucky—famous for its beautiful women, fast horses, and good whiskey—possesses a soil that has an ideal combination of chemical elements, particularly elements such as manganese, calcium, phosphorus, nitrogen, iodine, and potash, but also many other less evident elements, of which we have little knowledge.

Certain soils of Florida become productive on the addition of small quantities of manganese salts, others require minute quantities of copper salts. It appears that cobalt is lacking in certain soils of New Zealand, as the addition of cobalt salts to the feed of sheep wards off a sickness that was prevalent before the discovery of this remedy.

Goiter is prevalent in mankind and animals in regions deficient in iodine. Dosing the drinking water with potassium iodide or adding this element to salt has been proposed as a remedy.

Slowly we are gaining information which indicates that a large number of elements are necessary in the soils if people and plants and animals are to thrive and remain sturdy and healthy.

* Fifteenth annual Sigma Xi address, Atlantic City, N. J., Tuesday, December 29, 1936.

On the other hand, an excess of certain elements may be undesirable, although in moderate quantities they may be beneficial. For example, the heavy accumulations of alkali salts, in the arid regions of the world, and the accumulations of borax, in certain areas of the West, result in crop injury; and the excess flourine in drinking waters cause mottling of the teeth and possibly other pathological changes in man and animals. But the one element that appears to serve no useful purpose in any amount in the soil and which is toxic to both plants and animals is *selenium*. Each year thousands of cattle and sheep in the western states succumb from eating plants that have absorbed selenium from the soils on which they grew. In years past I, personally, have followed the course of a band of sheep for a distance of more than twenty miles across the high plains of southern Wyoming, by the bloated carcasses of dead animals poisoned by ingesting woody aster which I now know contains enormous quantities of selenium. At that time I was of the opinion that the poison was organic and for years searched for it without result. It is known today, however, that the selenium in the soil is the culprit that has been causing many of these troubles, and it is my purpose at this time to single out selenium, as one of the undesirable elements in the soil, and tell you what the Bureau of Chemistry and Soils has learned during the few years we have been studying it.

Selenium is a twin sister to sulphur. It came into notoriety rather suddenly after nearly a century of search for the cause of such troublesome western livestock diseases as "blind staggers" and "alkali disease."

Until about four years ago selenium occupied a modest place in the list of chemical elements, standing about fortieth in order of abundance. It was used in making red glass and such articles as the selenium cell, self-lighting buoys, and airplane compasses. Other than its rather limited use in these fields it was a useless by-product of smelters, about one hundred tons a year being produced in this country and smaller quantities elsewhere. But the story is different today. Now, selenium is in the limelight because it is known to be injurious to both people and animals when taken in sufficient quantities, and because it is useful in making insecticides and certain kinds of steel.

The results of investigations by the Bureau of Chemistry and Soils during the last five years show that selenium is present in large enough quantities to make it an agricultural problem in the soils and vegetation in many parts of the country. The results of our investigations indicate that toxic seleniferous areas are found correlated with certain geological formations, particularly the Pierre and Niobrara shales and other members of the Cretaceous period. Investigations also indicate that a large area of soils in the Great Plains States, capable of producing toxic vegetation, developed from these shales. The area already studied includes parts of Wyoming, Montana, South Dakota, Colorado, Nebraska, Kansas, Utah, Arizona, New Mexico and Canada. The quantity of selenium found in some of these soils is negligible, while in others it is great enough to injure certain plants and to destroy animals which consume them. Results thus far indicate that selenium is widely distributed throughout the soils of the world. Studies are under way now to find out to what extent it is

contained in the principal agricultural soils of the United States, Hawaii, Puerto Rico and elsewhere.

What we know about selenium today is largely the result of the combined efforts of the Wyoming and South Dakota Agricultural Experiment Stations, the United States Department of Agriculture, and the Public Health Service. At a conference of investigators in the Department of Agriculture in 1931, it was suggested that selenium poisoning might be the cause of the "alkali diseases" that were resulting in losses of livestock on the Great Plains. This proved to be a correct hunch, and that was the beginning of the interest of the Bureau of Chemistry and Soils in the selenium problem. From that time on we have been working in cooperation with other bureaus of the Department of Agriculture and with the state agricultural experiment stations to unravel this selenium mystery which has caused such heavy livestock losses in the seleniferous areas of the West. We were given a special appropriation of \$10,000 to make a study of the selenium problem, and Dr. H. G. Byers, of the Soil Chemistry and Physics Research Division of the Bureau, was placed in charge of the investigation.

One of the first problems in connection with these investigations was to develop a method for detecting selenium in small quantities. Up to the time these investigations were started such methods had not been developed because there had been no need for them. Within a few months new and accurate methods were developed, which showed the presence of selenium in as small quantities as fractions of a part per million in soils and plants, and even fractional parts per billion in water. This gave a very powerful weapon for our investigations.

And now that you have the background as to what selenium is and why it is in the limelight today, I'll tell you some of the things we have learned about it. But before presenting them, I wish to say that the Bureau of Chemistry and Soils does not, by any means, take credit for all the accomplishments. We have done our part, of course, as best we could, but much credit is due to the late Doctor Franke of the South Dakota Experiment Station, Doctor Beath of the Wyoming Experiment Station, Doctors Williams and Sayers of the Public Health Service, Doctor Munsell, Bureau of Home Economics, Doctor Karrer of the Bureau of Plant Industry, and others, both in and out of government service. In fact, this problem is one of the outstanding examples of what may be accomplished by cooperative effort in the field of research. Results were obtained in a short time, which could not have been hoped for in years of individual effort.

Two of the most valuable facts that have been disclosed are that selenium in notable concentration is usually associated with certain definite geological formations, and in soils derived therefrom, and that it is troublesome only in regions of light rainfall.

The relation of selenium to *plants* that grow on seleniferous soils is important, not only because of the damage these plants may cause but also by reason of diminished yields in pasture or in crops. Investigations show that wherever selenium is present in the soil, all plants absorb some of this element, varying in quantity from mere traces to thousands of parts per million.

Although we have not gathered enough information to make a definite statement as to how much selenium a soil may contain without being dangerous, in general it appears that any soil containing more than five-tenths part per million of selenium or any vegetation containing over four parts per million is potentially dangerous. The danger varies, not only with the quantity, but depends in part on the form of selenium present and on climatic and, possibly, other conditions.

One of the interesting as well as mysterious facts our studies reveal is the difference in the tendency of various plants to accumulate selenium when growing on seleniferous soils. For example, most native prairie grasses show little tendency to take up selenium. Other species of plants, including some of the legumes, absorb selenium in large quantities. Western wheatgrass, however, growing on various soils, has been found to contain selenium in quantities varying from 1 to 60 parts per million, and certain milk vetches, which are wild legumes, have been found to contain as much as 5,600 parts per million. Wheat and the cultivated cereals seem to fall in an intermediate class between these two extremes.

A question that naturally arises is, how does the selenium that the plant absorbs from the soil affect the appearance and structure of the plant? That, by the way, is an important point because, with the exception of odor, in some cases there is no telltale sign in the field plant to prove or disprove that the soil on which it is growing is seleniferous or that the plant itself contains selenium. One would never suspect from the appearance of wheat, cabbage, barley, and so on that they have accumulated dangerous quantities of this element, even though it has been shown that crop yields are greatly lessened by its presence in the soil.

But in the affected areas there are many so-called "indicator plants" that betray the presence of selenium in the soil. Certain species of astragalus (milk vetches) are among these, and if there is any available selenium in the soil the roots of these plants absorb it readily. So do woody aster, goldenweed (*oonopsis foliosa*) or (*aplapappus fremontii*) and a number of other plants common to the more arid parts of the Great Plains. These and similar plants have been responsible for the death of thousands of head of sheep and cattle in the range country. These plants may take up so much selenium that less than a pound of the plant has been known to kill a sheep. Some of our investigators claim they can locate selenium-bearing soils by means of observation only of the plant and soil associations. I haven't yet become so proficient, but I am of the opinion that there is considerable truth in the statement.

It should be pointed out also that our investigations show that plants vary in their selenium concentration at different periods of growth, and that roots, stems, leaves, and fruit of the same plant are not equally toxic. Observations made thus far of the distribution of selenium in plants indicate that this element is higher in the seeds, blossoms, and leaves, lower in the stems, and least in the roots.

The next question is, what happens to animals when they eat these seleniferous plants? The answer is not simple. They succumb at once if they consume enough of a highly toxic plant. That is why the problem is so serious in some

parts of the West. Grazing sheep and cattle have been killed by the thousands in the seleniferous areas of the Great Plains, when forced to eat these poisonous plants because of droughts or scarcity of feed. And *forced* is the right word, because investigations show that livestock, as a rule, do not eat plants that contain large quantities of selenium unless they are forced to do so, or unless they are unfamiliar with the plants. Some plants high in selenium have an odor that is highly suggestive of decomposing eggs, and domestic animals ordinarily will avoid plants unless starved to it. However, even when foods are not odoriferous apparently animals learn to distinguish between the harmless and the harmful.

But an animal may be injured by consuming smaller quantities of seleniferous plants. It may not get enough to prove immediately fatal, but sufficient to produce an "inebriate" condition. This condition is variously known as "locoism" or "blind staggers" and the animal may die within a few hours or days, or it may recover after a time. However, it is not suggested that all "loco" trouble is due to seleniferous vegetation. There are other causes. In case an animal consumes seleniferous foods of lower concentration or over a longer period, the quantity of selenium consumed may be sufficient to stunt its growth and cause loss of hair, particularly of the mane or tail, and cause its hoofs to slough off. This condition is sometimes called "alkali disease." Animals that are only slightly injured usually recover when placed on normal feed, but the most severely selenized animals succumb or become so helpless that they must be destroyed.

One of the most interesting items of research in connection with the effect of selenium on animals was one pertaining to chickens conducted by Doctor Franke and Doctor Tully of the South Dakota Agricultural Experiment Station. Their investigations showed that eggs produced on farms highly affected with selenium hatched poorly, if at all. In their research, approximately 75 percent of the eggs which failed to hatch on the twenty-first day contained deformed embryos. The hatchability was very low, ranging from 4 to 12 percent. Chicks from some of the eggs that hatched lived only a few hours, and their down was greasy instead of fluffy as it is in a normal hatch.

In the feeding test, the growth was stunted when the chicks were fed a ration containing 65 percent of seleniferous grains, but the chicks made practically normal growth when the ration contained only 25 percent of the toxic grains or less than about four parts per million of selenium in the total diet. Egg production dropped when hens were on the 65 percent ration. By injecting selenium into eggs before incubation, the investigators were able to produce such freaks as chicks without beaks, without eyes, and even missing legs. In other words, there is no doubt as to the effect selenium has on animal embryos.

The ingestion of seleniferous plants not only retards the rate of growth, but if the quantity consumed is sufficient it results in troubles known as "blind staggers" and "alkali disease." Alkali disease is the less acute form of seleniferous poisoning and is characterized by the loss of hair and the sloughing off of hoofs. Blind staggers is an acute type of poisoning, which is prevalent among the range cattle in certain sections of the West, and it results in death in a comparatively short time. There is no sloughing of hoofs or loss of hair

in typical cases of blind staggers. Both diseases are characterized by similar injuries to the liver. It is believed that both diseases may be produced by the same agent, that the agent is selenium absorbed from the soil by plants which are eaten by livestock. As might be expected both types of poisoning are frequently found in the same locality.

At this point let us examine a few interesting historical facts:

The first is a statement by Marco Polo, written about 1295 A.D.,¹ discussing a situation in the Nan-Shan Mountains on the border between Eastern Turkestan and China proper. I quote:

"Throughout all the mountainous parts of it the most excellent kind of rhubarb is produced, in large quantities, and the merchants who come to buy it convey it to all parts of the world. It is a fact that when they take that road, they cannot venture amongst the mountains with any beasts of burden excepting those accustomed to the country, on account of a poisonous plant growing there, which, if eaten by them, has the effect of causing the hoofs of the animals to drop off. Those of the country, however, being aware of its dangerous quality, take care to avoid it."

Mr. Aurel Stein, who traveled in Eastern Turkestan 1906-08 as a representative of the British Government, recounts the following experiences²:

"I was just gleefully reflecting how our ponies would revel in their alpine pasture when Sahib Bai . . . came up with alarmed mien to report that five of the animals were standing about benumbed and refusing to touch grass or fodder. I at once suspected that they had eaten of the poisonous grass which infests certain parts of the Nan-Shan, and about which old Marco has much to tell in his chapter on 'Sukchur' or Su-chou. The Venetian's account had proved quite true; for while my own ponies showed all the effects of this inebriating plant, the local animals had evidently been wary of it. . . ."

In the United States, probably the first written mention of troubles now known to be due to selenium is found in a statistical report on sickness and mortality among horses of the army of the United States by T. C. Madison.³ In this report Doctor Madison, an army surgeon, calls attention to a "very fatal disease" which manifested itself in August, 1856, among the cavalry horses at Fort Randall in the then Nebraska Territory. He recognized the disease as new and gave a very satisfactory description of its symptoms. He also correctly ascribed the origin of the trouble to the pasturage. An examination of the area referred to was made in 1934, by the Bureau and selenium was found in toxic quantities in the herbage. In fact, it was possible after a lapse of more than three-quarters of a century to reconstruct a map and show in just what area the horses were pastured that suffered from the "disease."

During the summer of 1936 Mr. Miller of the Bureau of Chemistry and Soils visited Forest Ranger Paul Gilbert, in the St. Isabel National Forest, with headquarters at Gardiner, Colorado. Mr. Gilbert showed Mr. Miller a small gulch, about forty miles southwest of Pueblo, in which, in September,

1931, a flock of 200 sheep, coming out of the mountains, had been pastured overnight. In the morning 197 of these were dead. In September, 1932, a flock of 157 head was turned into the same gulch, and in the morning 71 were dead. No report is available concerning the fate of the survivors. However, no sheep have been allowed in this area since 1932. This gulch has an area of about one-half square mile.

Mr. Miller collected samples of the soil and of the vegetation from this area. The forage available consisted almost wholly of woody aster, *Astragalus racemosus*, and lambsquarters. Samples of these plants were collected, also samples of the soil on which they grew. The soil samples contained approximately three parts per million of selenium; the *Astragalus racemosus* contained 680, the woody aster 1,750, and the lambsquarters 890. A similar species of *Astragalus* found in Wyoming was reported by a rancher as being "relished by sheep."

Let us now turn to a discussion of selenium and public health.

It seems to be well established that the selenium content of the plants in some parts of the West is sufficient to injure and even kill livestock if the animals consume enough of the plants. It has also been established that wheat and other food and feed crops absorb some selenium when produced on highly seleniferous soils, and that meat, eggs and milk produced by animals feeding on these crops contain selenium. It seems inevitable that human foods must contain selenium and that at times it may be in harmful quantities. But before some of you become convinced that your last ailment was caused by eating seleniferous food, let me hasten to say that there is hardly a chance, outside of a seleniferous area, of a person obtaining enough selenium to injure him in the ordinary foods of today. A farmer who lives on a highly seleniferous farm might have cause to worry if he produced everything he ate on his own farm and brought in nothing from the outside. But that is not often the case today, because the diet of the average individual is a mixture of foods from the four corners of the earth. The foods that contain selenium in appreciable quantities are mixed and diluted with foods from non-seleniferous areas, so that there is no need to worry so long as your flour comes from the big milling centers, your vegetables from one part of the country, your fruits from another, and so on down the list. I shall not be concerned over the amount of selenium that may have been in the dinner I ate tonight. If a person should eat his average of 170 pounds of wheat flour a year and the flour contained five parts per million of selenium he would only ingest $1\frac{1}{2}$ milligrams of selenium a day, whereas it would require something like 300 milligrams consumed one time to produce fatal results. The effect of long-continued ingestion of minute amounts of selenium has not been determined. While there is no immediate general concern from the standpoint of health, it is a problem of acute local interest. I'm glad to say that the United States Public Health Service is working on it with some interesting preliminary published results.

You might infer also, that since a selenium diet causes animals to lose their hair, it may be the cause of ballheadedness in man. But we have no evidence that this is so. I'm quite sure I didn't lose my hair by eating seleniferous foods. The fact is I was not raised in a seleniferous area (this fact has been determined

experimentally) and I have little hope of restoring the growth by refusing foods that come from highly selenized soils.

The origin of selenium in soils and the proposed remedies are of interest at this point.

The Hawaiian Islands give us a clue to the origin. Doctor Byers has evidence that the selenium in the soils of Hawaii is derived from volcanic gases and is carried down into the soils by rains and held in a highly insoluble form. It appears probable that the selenium in the soils of the United States is also of volcanic origin. Rainfall probably brought it down from the volcanic areas to the sea, in which the shales of the upper Cretaceous period were formed. These shales are the parent material of present soils. If this assumption is correct, the formations in which selenium are most abundant were deposited contemporaneously with periods of high volcanic activity in the Rocky Mountains, and sheep and cattle of today die as a result of volcanic eruptions of 70 to 150 million years ago.

The problem of ridding the soils of selenium is difficult and probably impossible of solution. There are methods, however, of minimizing its injurious effects. There appears to be no injury in places where the rainfall is sufficiently high or where irrigation with adequate underdrainage is practicable. So far as we know there is no selenium problem in sections where the rainfall is as heavy as it is in the eastern half of the United States, and but little injury has been detected in four irrigation areas where investigations have been made. The most serious problems pertaining to selenium are found where the annual rainfall is twenty inches or less. In such regions there is not enough water to carry away the soluble selenium compounds and they stay in the soil and may be taken up by plants. I might add that it is possible to find traces of selenium in practically all soils, but the quantity found in most soils even in subhumid areas is insufficient to produce actively toxic vegetation.

I am not trying to minimize the importance of the selenium problem. I am merely trying to point out that, *so far as we know*, it is not really a problem except in certain arid and semiarid regions of the West. But *there* it is a *serious problem*, because it poisons the plants that livestock use for grazing and is a health hazard in such regions where food for humans is produced.

The situation is not seriously alarming and will become less so as we extend our investigations, and learn what areas are affected, and decide how each may be best controlled. There is need for more research. Only a small percentage of the soils of the country have been examined for selenium. This work ought to be carried further, until we have complete knowledge of the extent of our seleniferous soils.

By no means have all plants been examined. There may be plants that we have not examined that are more deadly than those studied, and it seems certain that toxic associations exist in some plants.

All soils that contain selenium do not produce toxic plants. Certain areas bear little or no toxic vegetation, even where considerable quantities of selenium are found in the soil. This partly unexplained variation suggests an important problem for further research.

We need more information on what are called "converter plants." There is considerable evidence that certain native plants, like the *Astragalus bisulcatus*, absorb selenium from virgin shale-derived soils, convert it into water-soluble forms, and return it to the soils in forms that other types of plants, including farm crops, can use. Hence it may be said to build up local toxic soils.

What is to be done about it? While there doesn't seem to be much danger to the general public health we should know with certainty the hazards which exist, both in the seleniferous areas and in the various industrial operations where selenium and its compounds are prepared and used.

Sulphur is a constituent of all plants. Since selenium is a twin sister to sulphur, it has been suggested that possibly where the soil is lacking in sulphur and selenium is present the selenium enters the plant in the place of sulphur and results disastrously to the plant or to the animals that consume such plants. We do know that the addition of large quantities of sulphur to seleniferous soils reduces the absorption of selenium by plants to a considerable extent. Is such treatment a practical remedial measure?

The work on selenium emphasizes the fact that in many respects the soil is the wastebasket of the world, a rather leaky wastebasket it is true, and like most wastebaskets the contents depend on what is brought to it. Further, selenium is the first element discovered in the soil that seems to serve no useful purpose whatsoever, even in extremely small quantities in the economy of life except for those plants—"selenium lovers"—which apparently grow and thrive only on seleniferous soils. To domestic plants and especially to domestic animals it is decidedly a health hazard.

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1. "The Travels of Marco Polo," Manuel Komroff, ed., Chap. 43, p. 81.
2. "Ruins of Desert Cathay," vol. 2, p. 303.
3. 1860 Sanitary Report—Fort Randall, U. S. Cong. 36th, 1st Sess. Sen. Ex. Doc. 52:37-41.

SCIENTIFIC PLANNING IN CITIES

G. H. SHEPARD*

The general neglect of planning by American municipalities, and the value of planning as a basis for economical administration, make a discussion of the problem important.

In the work of improvement of industrial management in the fifty-three years since Frederick W. Taylor began his work, scientific planning has won a prominent place and has developed a highly skilled technique in design, installation and operation.

Industrial management has thus developed a fund of theory and practice on this subject, which is available for application in other fields.

At the same time the question of a national planned economic order looms big in the future, and is already becoming a political issue. It is sound doctrine that so radical a change in our methods as is involved in a planned economic order, should be tried out first in small units; for example, in cities and counties.

A planned economic order, to be an industrial engineer, means something very different from what it seems to mean to most people. At least the opponents of the idea seem to understand by it, a very centralized control in detail. Industrial engineers know by hard experience that that will not work. It was first tried in planning systems for factories, and results forced engineers to decentralize planning. Such valuable experience should keep reformers from repeating our mistakes on a grand scale.

Should a city plan in advance; and, if so, why?

The City Plan Board of Dayton, Ohio, in its pamphlet, *Dayton and Its City Plan*, answers this question very well.

The Dayton board argues as follows:

"The modern city is a very complex organism, and the proper coordination of its parts and functions can be achieved only by careful design and planning far in advance:

"The results of the contrary practice are confusion, congestion of all kinds, misfits, lack of adequate light, air and open space; a general lessening of efficiency, comfort, health and livability; and very excessive cost."

The Dayton City Plan Board's answer refers to one phase of the question, the physical building of the city. There is another, namely, the financial. In the *Chicago Tribune* for June 30, 1933, Philip Hampson says:

"Recent market lists of city and state bonds disclose that some are being offered at prices which indicate sound financial positions on the part of the issuing governmental units, with their budgets in balance.

" . . . The investor who desired to buy a portion of a \$5,000 issue of the town of Stamford, 6 percent bonds, due April 1, 1934, was able to get a yield of only 3.5 percent. With a budget that balanced, this town's

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offering was considered sufficiently safe by the investor to warrant his taking a return only .5 percent higher than the former customary bank interest rate of 3 percent. . . .

"Despite the severe financial pressure which has borne down on many municipalities, many of them are still able to borrow money at 3.5 to 4.5 percent. This could only be possible where taxes are being collected in sufficient amounts to meet expenditures—where budgets are balanced or are very close to being so. Some cities were fortunate enough to have established surpluses in good years on which to draw in lean years."

Balanced budgets and surpluses do not come by chance. They result only from careful planning in advance.

As Mayor Daniel W. Hoan of Milwaukee said in a radio address on February 5, 1932:

"There must be a sound financial program to gradually overcome the borrowing habit, as Milwaukee is doing, and thus lessen the burden of interest payment."

The only planning that we found in two Indiana cities studied by us was that each of them, once a year, made out a financial budget for a year in advance.

Their budget practice was good with the following exceptions:

The budget figures were hardly better than loose estimates, based almost entirely on the expenses of previous years, usually merely on the figures for the two years last past;

There was no follow-up and control of actual expenses at frequent intervals, such as a well-managed business practices, to keep them down to budget allowances; consequently a head of department was likely to spend his entire appropriation long before the end of the year, in which case the council would give him an emergency appropriation to see him through the year.

There was no plan whatever beyond one year in advance, except an inadequate sinking fund to pay off bonds at maturity, so that the budget represents at best only a very short-sighted planning.

How can these cities, and others like them, obtain from planning such benefits as American industry is continually more and more deriving from the practice?

There is no royal road. Some group of citizens must want planning badly enough to organize for it, to work for it and to fight for it.

Such an organization of citizens will come into being if there are some definite objectives; and to these, if the organization lives, will succeed others. All American government is designed to be responsive to the will of the people, so that, as soon as such an organization has the backing of any considerable portion of the community, it will be in a position to attain its objectives, no matter what may be the form of the city charter, by political pressure on the city government.

The determination and attainment of these objectives will constitute a sort of planning, though very far from the sort which has proved essential to successful industry. Nevertheless the results may be very valuable.

These objectives will be different in every community. We suggest a few. In the first place the citizens' organization will need, in the municipal government, a good tool with which to work.

There are three principal types of municipal government in the United States, of which two may be subdivided into two varieties each. They are:

The mayor-council type, subdivided into

The strong mayor, or responsible executive, variety; and
The weak mayor variety;

The commission type: and

The city-manager type subdivided into

The mayor-council-manager variety and
The council-manager variety.

Any of these except the weak mayor variety may be expected to work well under the eyes of an alert, interested, intelligent and competent electorate; and it is certain that none of the five will work well without such supervision. No one of the five is either fool-proof or knave-proof, or could possibly be made so.

The city manager type of municipal government warrants further discussion, especially as the writer has recently heard the manager of a large American city, in a public address, take the view that municipal government consists entirely and exclusively in practical service to the community, as if it were a sort of municipally owned public utility and nothing more. The writer believes this view to be fundamentally wrong and fraught with dangerous possibilities.

The city manager type of municipal government is a development from the commission type and is intended to remedy its defects. To do this it places the whole city administration under a city manager.

As to the mayor-council-manager variety of this type, its greatest disadvantage is that it is an unfamiliar form of organization. This may seem like a strange statement, because it is usually said that this is strictly a business organization, patterned after the familiar board of directors and president of a business corporation, the city manager corresponding to the president.

On the contrary, the mayor-council-manager variety of the city manager type corresponds to a rather unusual form of business organization, in which there is a board of directors, a president who deals with the stockholders, the board of directors and the outside world in general, and a general manager, subordinate to the president, who handles internal administration only.

It is important that there should be administration of the city's affairs by competent expert executives; and such men can be secured only by giving them adequate salaries and reasonable security of tenure; and these can be given only by relieving these experts of the hazards of politics; and this relief can be afforded only by taking administration out of politics altogether.

Nevertheless, questions of policy must be settled; the questions of policy are questions of politics.

The mayor-council-manager variety of the city manager type tries to accomplish the separation of policy and politics from administration by providing a mayor and council, who are expected to determine all questions of

policy, and then putting administration entirely and exclusively under the manager.

Under this form, therefore, the mayor, and not the city manager, corresponds to the president of the corporation; the council corresponds to the board of directors; and the city manager corresponds to the general manager.

Under the council-manager variety of the city manager type, there is in form and theory a close correspondence to the business organization with a president and board of directors; but it is rarely possible for the manager to attain such leadership of the electorate as the president of the corporation naturally has of the stockholders, so that the manager can hardly avoid the position of a subordinate to the council.

Experience with the city manager type has shown that it is in the determination of policy that it is most likely to fail.

If the council, or the mayor and council, fail to determine policy correctly and adequately, administration must be unsatisfactory. Since the city manager is popularly supposed to be the real head of the city government, he probably gets the blame. Since he is dependent on his job for his livelihood, he is apt at this stage to try to become a civic leader and so to get himself into politics. Then, if the electorate turns down his policy, it usually elects a council which will turn down the city manager; and there is an end to expert administration by a professional executive.

The council, or the mayor and council, are commonly forbidden by statute or charter to interfere with the city manager's administration, and penalties are sometimes prescribed for so doing. As the council, or the mayor and council, have the power to remove the manager at any time, it is not to be supposed that interference by them would have to go beyond the point of mere informal suggestion. It is therefore impossible to expect that administration by the city manager will be efficient and successful, unless the council, or the mayor and council, are in favor of it and want it to be so.

It is therefore essential to successful administration by a city manager, that the citizens' organization should secure the election of the kind of a council, or mayor and council, who will attend competently to their own job of determining policy and leave administration to the city manager.

A few other immediate objectives of planning may be suggested.

In order that a budget may be successful, estimates of necessary expenses must come pretty close to the facts. Otherwise expenses are almost sure to overrun the budget, with the results that money will be borrowed on short-time loans to meet deficits; resulting in the addition of the necessary interest to the city's expenses and in bringing the budget into disrepute as useless.

The means which are commonly used to test in advance the accuracy of the budget are merely the comparison of its estimates with previous expenditures for the same purposes, usually for the two years last past.

This procedure may cause enough money to be appropriated and raised by taxation, but has very little bearing on the question of whether the city is going to get its money's worth. For that purpose unit costs are much more valuable.

For the immediate determination of unit costs, the results in other cities, preferably those as nearly similar as possible, may be used. All the various classes of service rendered by the city such as police and fire protection, sanitation, water and sewer service, city lighting, education, poor relief and so forth, may be studied in this way. Costs of these various services may be reduced to so much per unit suitable to the class of service. For example, cost of police protection per capita in a neighboring city may be compared with one's own. Cost per capita for city lighting might give valuable information, but cost per mile of street would be much more likely to do so. While unit costs will probably vary from city to city, if the city's unit costs were compared with those of ten or more similar cities and were found to be high in a large proportion of cases, wasteful administration would be definitely indicated. Such unit costs are especially valuable in connection with public works, because the unit costs of similar engineering projects ought to be nearly constant over a wide area.

In order to control expenditures it has become standard practice in industrial concerns to have all purchasing done by one department, which specializes in that work. Municipalities would profit by emulating that policy.

In many cities a board of public works does most of the city's purchasing. A simple way to obtain a specialized purchasing department would be to expand the functions of the board of public works in this respect by creating a purchasing office for the whole city as one of its divisions.

Cincinnati, with her slogan, "The best managed city in the United States," has consolidated the buying of the county, city and the board of education in one purchasing office.

A city's account ought to be kept in such a way that costs per unit can be ascertained. One of the proper objectives of a citizen's organization might well be to secure the installation of such a system of cost accounting as is used by well-managed industrial concerns.

In order that expenditures may be controlled according to the budget, it is necessary that they should be checked against the budget at least as often as once a month. In a well-managed industrial concern this is done by means of the operating efficiency statement. After the budget has been determined for the year, it is divided into separate parts for each cost period. Promptly at the end of each cost period, the accounting department provides every responsible executive with a statement in which the total of every classification of his expenses for the period is compared with the budget allotment for the period and with standard cost based on unit standard costs.

In order that the accounts may be reliable, it is necessary that they should be audited. As a final check on the audit, a well-managed industrial concern has its accounts audited at least once a year by some outside certified public accountant. Such an outside audit is exactly as necessary in the case of a city.

Besides such measures as are suggested above, the citizens' organization in any community will have other projects which it desires to carry out as soon as possible. Such projects may be very worthy and desirable, but they are practically certain to be suggested by mere opportunism, as, for example, the

desire of every community at this time to get its share of benefit from the federal treasury.

Such projects will probably be so poorly coordinated with each other and with the general situation that they will, in the long run, prove to be unnecessarily expensive. In order that they may be better coordinated, it is necessary to have a general plan for a long time ahead.

The pamphlet, "Dayton and Its City Plan," states that the plan "lists a long series of necessary improvements in the order that these will be needed and should be undertaken during the next twenty or thirty years."

Through lack of such planning in advance, the city in which the writer lives has become shut into such a degree that, except at great difficulty and expense, it can now grow in only one direction. Similar things are likely to happen to any city, but can be prevented by having a well-considered plan for a long time ahead.

During the boom years from 1921 to 1929 everybody knew that a depression would come sooner or later. It would have been wise policy for a city during the boom years and with a long-time financial plan to have accumulated a surplus. The interest on such a surplus would have been revenue. The city of Dayton, Ohio, saves a handsome sum annually by investing a similar fund in its own bonds. During the depression such a city would not be compelled to deny itself necessary public improvements, like additions to the sewer system, because it could not raise the necessary money either by taxation or borrowing. Moreover, the construction of such works during the depression would have relieved unemployment and would have reduced, possibly avoided, the large sums spent in poor relief. The money spent on the dole is gone and cannot be recovered, while the improvements would have been a permanent asset to the community. In addition the intangible benefits due to the stabilization of employment would have been beyond estimate.

These things require, not merely an immediate opportunistic plan to get some federal funds on easy terms, but a well-considered, thoroughly worked out plan for decades ahead.

The basis of all such plans must obviously be a physical plan of the city.

Zoning constitutes a large and difficult part of the plan and one which is especially apt to involve the city in litigation. The powers of most American municipalities are closely limited by their charters and by statutes, and the courts follow the practice of construing such limitations strictly and with the presumption against the city. The city's police power includes the establishment of zoning plans and regulations only if a state enabling act has been passed.

Dayton's City Plan Board found it necessary to eliminate grade crossings; and, in order to do this, a bond issue of eight million dollars was necessary.

Thus it appears that the physical plan of the city immediately led to this and other financial plans for a long time ahead.

It is evident that, in any city, an adequate physical plan can be put into effect only through many resulting secondary plans of all sorts running far into the future.

After the experience of the last six years, no one is likely to dispute the proposition that one of the most important objectives, if not the most important

objective, of long-time municipal planning is the stabilization of taxation and employment. Besides what has been said above, it is evident that, once the city is guided by correct long-time plans, it can hold back during years of good business, when there is plenty of employment and prices are high, on public works which are not immediately necessary, can accumulate a financial surplus which will be a source of revenue; and then, during periods of depression, can spend the surplus on needed public works and at the same time can keep down taxation, provide employment and prevent distress. Also it will thereby pay for most of its public works during periods of low prices and therefore at minimum cost (though this conclusion is disputed by some authorities).

Such things as are involved in the physical plan of the city are major questions of policy, and therefore are the concern of the policy-determining organ of the city government; that is, of the council or the mayor and council. There is a tendency on the part of the American city electorate to take such matters away from the council; but the proper course of the citizens' organization is, instead, to secure the election of the right kind of mayor and council and have them do the work which properly belongs to them. Under the city manager type of municipal government the manager would, of course, be consulted; and the executive departments under his administration would be a principal source of needed information; but the task of preparing a physical plan of the city would be one for the council or mayor and council, not for the city manager.

A comprehensive physical plan for twenty or thirty years ahead should result in a comprehensive financial plan extending possibly not so far into the future as the physical plan, but at least five or ten years; and the determination of this financial plan is also a proper function of the policy-determining organ.

As the annual budget is then segregated and worked out in detail once every year, that part of the comprehensive financial plan which should be carried out in the next twelve months ahead is definitely decided. This segregation and detailing is a task of administration and therefore is a task for the mayor, under the mayor and council type of municipal government; for the commission under the commission type; and for the city manager under this type. The approval or disapproval of the detailed annual budget is then a question of policy; and as such, belongs to the council, or to the mayor and council.

While it is necessary to have a tentative physical plan extending far into the future, it is almost as bad to adhere rigidly to such a plan as it is to have no plan at all. The most conspicuous example of that sort of thing in this country is New York City. In 1811 New York adopted a city plan. The heavy traffic in those days was between Long Island and New Jersey; and the tremendous development of the hinterland and of the city itself was not dreamed of. The city plan therefore provided for east and west streets at short intervals, and for only a few north and south avenues wide apart. That design was reasonable enough then; and, if it had been followed as far north as 14th Street, it would have answered well enough, but the city unfortunately stuck to it through all the building from little old downtown New York with its crooked streets, all the way up to the Harlem River, with the result that the city now

moves its north and south traffic on three levels and still cannot relieve the congestion.

At present probably even more than in 1811 the future holds developments which are unpredictable. What city planning board twenty years ago would have included an airport in its plans? What city planning board today can say how large a proportion of traffic twenty, or even ten years from now, will be air borne?

Therefore the organization for planning must provide for modifying the plan so as to adapt it to changing conditions. It is also evident that the physical plan of the city must have considerable stability in order that it may be of any use whatever. The only way to reconcile these conflicting requirements is to have in the city government a permanent and competent organ, which will always be available to work out the solutions to such problems as they arise.

When American cities began to preplan zoning, it was the custom to appoint a planning commission, have it draw up the desired plan, and then go out of existence. The supposition evidently was that its work was finished. It is evident that its work never is, or can be, finished, but that it must be continuously in process as a function of the city government. Also, in order that the physical plan of the city and the secondary plans, financial and other, which result from it, may have the necessary stability, it is essential that the personnel of the planning organ itself should have considerable stability; and that requires more permanence of personnel than is likely or probably desirable in the city council or the mayor and council. Also the preparation of the long-time plans of the city requires a vast amount of work, more than can possibly be performed by the city council, or the mayor and council. It is, therefore, common for them to delegate this work to a subordinate commission, whose members are appointed for long terms with the terms of only one or two expiring each year.

Such a commission, however, should merely prepare the plans for submission to the city council or mayor and council. The passage of the ordinances by which the plans become authoritative should be the responsibility of the policy-determining organ of the city government.

The preparation of these plans involves so much work that it can be done correctly and adequately only by a competent staff which gives its whole time to the work. It is common to appoint a planning commission of prominent citizens who serve without pay. Unless they have the means and the disposition to do the work themselves, they must have the assistance of a sufficient and competent paid staff, to relieve them of all details.

In other words, planning will cost the city something; but the experience of industry is that, though planning does cost something, it saves far more than it costs.

Also the supreme planning organ of the city should prepare, for submission to the city council or mayor and council, not only the physical plan of the city, but all its long-time plans, financial and otherwise.

Long before city planning reaches any such degree of development as is contemplated in the previous paragraph, the citizens' organization will have

found, if it did not know at the start, that the best laid plans go wrong, unless the execution of them is entrusted to the right kind of people.

The personnel of the policy-determining organ, of course, will be selected by the voters by political election.

Under usual city charters, most of the city's higher executives will be appointed by the mayor or by the city manager, very likely subject to approval by the council, or by the commission under that type of municipal government; and it is desirable that such appointing authorities should have a free hand. Lower down the grades of the city's employees, if good administration is to be obtained, it is necessary that some regular systematic method of selection and promotion should be employed. In many states this matter is regulated by state civil service statutes and is administered by civil service commissions. In this case the citizens' organization may well pay attention to the way the civil service commission does its work. Even if there are no civil service rules, there is no reason for failing to employ an adequate merit system. This is a matter which has received great attention in industry during the last twenty-five years; and a well-managed industrial concern of any size has a personnel department to attend to it. The technique of such industrial personnel departments is well developed, and is available for the use of government. The citizens' organization may well be interested to see that it receives due application.

A well-managed industrial concern not only has its supreme planning organ, which works out its general plans for a long time ahead, but it has a complete graduation of planning organs down to one for the individual shop, which probably consists of the shop foreman and a clerk, and which works out from hour to hour, and despatches, the plans of that shop according to the general plan.

This is a matter which has never been worked out for any municipality known to the writer, and experience is lacking. Also industrial experience has shown that a planning system has to fit local conditions very closely; so that any suggestion with reference to the unexplored problem of municipal short-time planning must be made with great caution.

Probably the only suggestion which it would be safe to make is for the proper local authority to appoint a commission consisting of industrialists whose businesses are well planned from top to bottom and of principal members of their planning staffs, and let them wrestle with the problem and suggest a design suited to local conditions; or, if such local talent is lacking, to employ a competent consultant in that line to design the local planning system.

Such short-time detail planning evidently has to be done; and it must be well done if work is to be accomplished at minimum cost. If there is no planning organization to do it, the task devolves, in industry, upon the executives—the managers, superintendents and foremen. Experience shows that they have too much else to do to attend adequately and correctly to the details of it; and that, for that purpose, they need the help of a planning organization.

DR. WILLIAM ALANSON WHITE

During the week following the installation of the George Washington Chapter Doctor White, internationally known psychiatrist and superintendent of St. Elizabeth Hospital in Washington, was stricken with influenza and pneumonia, and died March 7. The *Washington Star* for March 8 contained the following editorial:

"Washington parts with Dr. William Alanson White with profound regret. He was a citizen who held the respect and high regard of the community during a third of a century. In his work as superintendent of St. Elizabeth's Hospital he discharged with distinction an exceedingly difficult duty. The position he held so long and with such notable credit was one which demanded the qualities which he possessed. A man less skilled, less tactful, less kindly and considerate certainly would have failed where he conspicuously succeeded.

"Hundreds of individuals owed to him their restoration to health, still others were indebted to him for the contribution he made to human progress through his services to a great number of learned societies pledged to the basic welfare of the race. As a writer he reached a universal public concerned to read the riddle of intellectual and emotional adjustment to the problems of existence. In every respect he was a builder—a physician who knew that the conquest of "a sea of troubles" can be achieved only by gradual progressive comprehension of the elemental causes of the turmoil and the strife.

"The institution over which he presided will continue to be endowed with the tradition which he established. His name will endure, and the example he set will be an inspiration to those who take up the task from which he has been called untimely. Washington bids him farewell with appreciation and heartfelt gratitude."

THE FUNCTION OF EDUCATION AS VIEWED FROM THE STANDPOINT OF THE PRESENT WORLD CRISIS

WILLIAM ALANSON WHITE

A number of years ago the President of the United States called to his office Mr. John Joy Edson, one of the greatest philanthropists that this city has ever produced, and said to him, in substance: "Mr. Edson, I want you to head up a committee to look into the conduct and construction of the prisons of the United States in order that you may form an opinion as to the needs in that respect of the District of Columbia, and as a result of your researches and deliberations I want you to draw up a plan for such an institution." Mr. Edson was somewhat dumbfounded by this request and replied by saying: "But, Mr. President, I have never been in a prison in my life," to which the President replied: "That is exactly the reason I want you. I want an unprejudiced opinion." As probably most of you know, this committee functioned in the way outlined and the result was Occoquan, which has fulfilled the hopes that Mr. Edson had. The interesting part of the story, however, is that this experiment which was carried to a successful issue was agreed to by only two wardens in the United States. In other words, the President's feeling about prejudice was fully sustained. He felt that if the prison authorities were consulted they would make recommendations along the usual stereotyped lines that had been in operation for many years. Now it is interesting what Mr. Edson found. His interpretation of his researches into American prisons can be expressed in a few words by saying that he felt when he got through that the rigid discipline of the prisons and even their construction of single cells were due entirely to a very few prisoners, that perhaps half a dozen out of every thousand men would belong to the type that were uncontrollable either by kindness or punishment. They were the few men for whom no one had ever found a technique that would deal with them successfully. Therefore the whole prison must be run upon lines dictated by their conduct. His idea of a prison was to segregate these very few men and deal with them separately, and then deal with the rest of the prisoners very much as one would deal with anyone else. And so Occoquan was built not in accordance with the cell system of construction but on the dormitory system. Men were not forbidden to speak in the dining-room but were permitted to converse, and the whole social atmosphere of the place was a distinct improvement over the usual prison and resulted in a humanization of the confinement which society thinks necessary for offenders.

I tell you this story because, as you will see from the title of my paper, I am going to speak on the subject of education, and I am quite as ignorant of the subject of education as Mr. Edson was of prisons. My only excuse in talking of it, therefore, is the same excuse that he would offer if he were here

today, and that is that my mind is open regarding it and that I am tolerant and unprejudiced.

To begin with, like the preacher, I feel that it might be helpful to have a text, and that text I will take from Marcus Aurelius. It is as follows: "What then is that which is able to conduct a man? One thing and only one, philosophy." And so with your permission I will philosophize for a few moments on the subject of education.

I do not need to tell this audience that we are living in a changing world, a world in which the changes are of such magnitude and come with such rapidity as to cause feelings of apprehension as to the stability, at least of certain aspects of our civilization. I do not need either to tell you that the salvation of this world is in the hands of the coming generations: the young men and the young women who are now graduating from college and the graduates who are going to be added to their ranks year after year, that we of the older generations will probably have little to say as to what the future brings forth. Therefore it is obviously a matter for serious consideration by all our educational institutions as to what sort of experiences they will subject their students to in preparation for this great responsibility.

In thinking over my own life and my own experiences in school and college, it seems to me—and I say "seems" advisedly because I know only too well how treacherous the memory is for one's youth—that in the first place I had an unusually splendid group of teachers from the very beginning to the very end of my educational career, men and women who were consecrated to their task, who were of high character and not only men and women of learning but of wisdom. Nevertheless as I look back upon those days and try to think what they taught me in terms of actual factual material I can hardly remember a thing. Most of the facts they taught me are either forgotten or else today they have ceased to be facts, and because of this personal experience I have felt very strongly that the teaching of facts was not a very important part of education. Of course we all know that the construction engineer has to have the ability to determine certain facts regarding the foundation upon which he is going to put his building, regarding the strength of material he is going to use and what strength he is going to need, that he must be able to calculate the breaking point of steel girders subjected to stresses of various kinds; and there are thousands of other things that he must know. But after all in the scheme of education I consider these on the whole as of minor importance. I believe that the greatest privilege that comes to the youth of this land is to sit under the instruction of men of ripe wisdom and of fine character, who are capable of inspiring in the student those qualities of curiosity and eagerness to learn and devotion to what they conceive to be their calling in life that make the true manhood and womanhood that we are aiming for.

The teacher occupies a tactical position of great strategic importance in the life of the student. The student goes to college, if he goes there at all seriously, with ideas of the wonders that he will learn there and of the marvelous men who know so much as to be his professors. These men must be first of all men of character, because the students will characteristically identify themselves with their beloved teachers and attempt to emulate them. It was Goethe who said,

"We learn only from those whom we love." This identification with the teacher is of especial significance where perhaps the home situation has broken down and the parents have ceased to be adequate models for the youth to follow.

Now there are two aspects of the educational problem from this point which seem to me of very great significance. The first one I have already intimated in my text, and that is that each young man as he starts out in the world should assemble himself sufficiently to know what he wants to do, not only what he wants to do with his whole heart and soul but what he must do. Stanley Hall used to say, in substance, that that thing which a man wanted to do if he wanted to do it with his whole self was something that he would be willing to die for. A student who enters the world with a task to perform that is as close to his heart as that need fear nothing. He is provided with an impenetrable armor against all attack. But the other thing which I am particularly anxious to speak of at this point is really the subject of my talk, and that is that education should not only be prepared to help the young person find his interests and satisfy his curiosity—in fact, I think it already largely does this—but it should attempt something more. If I have any criticism of our educational system it is that upon the whole—especially in the education of our very young children, and that is the most important period of their lives—it is too stereotyped and too standardized. The human individual is unique. There are no two human beings on the face of the earth that are alike and there never can be. And as for you and for me, we will never have our exact equals in all the thousands of years to come, and if we conceivably could, the world would be so different that these hypothetically similarly constituted individuals would really be different too. Now this unique individual material is all poured into one mold and subjected to one set of standards. There is no possibility that the best results can emerge from such a system.

Let me call your attention to one or two propositions that I think you will all agree with me are quite correct. One is that the man who has found his proper niche in life is infinitely happier than the man who has not. One of the great tragedies of an industrial civilization is that most of the human beings who comprise it have to work daily at tasks in which they have little interest and with which they cannot identify themselves in any adequate way, and they have to do this in order to live. The old craftsman apparently has disappeared forever and in his place there are the human cogs in the wheels of a mechanized world. We should have every understanding and sympathy with the lot of people whose lives must necessarily be devoted to such activities. Another proposition with which I think you will agree is that the person who is so interested in his work that his objectives that he is attempting in life are a part of his heart and soul retains his youth, his mental youth at any rate, longer than do others. He loves what he is doing. The wear and tear of the daily task is not so great. The strain of life upon him is much less. Now following these propositions I should like to put a question. It is a question which I know cannot be answered but it is a question for which we might seek and find an answer. Is it not possible for education to devise ways and means of helping to conserve the flexibility of youth, to maintain the alert curiosity and eagerness of that period of life, to stress more particularly these qualities

than just the addition to each individual of a certain number of measurable facts?

I have already spoken of this changing world. You will see the connection between my suggestion and that statement. Every time great changes have occurred in world ideologies they have been accompanied by great tragedies, especially when these ideologies were political and economic. If only the flexibility of youth could be retained somewhat longer or in somewhat larger measure, these changes which seemingly are inevitable and with regard to which we play a part of unknown importance, could be more readily negotiated. We know from our everyday experience that the oldsters among us hang on to the ideas of yesteryear, and the youngsters look forward with enthusiasm to the changes that are going to take place in the future. If we could lessen the crystallization that comes with the years we would find that the enthusiasms of youth would not meet with such rigid resistances from their elders. I have only one suggestion to make that would perhaps help to bring this about, and that is that the youth should be taught the historical development of ideas and precepts, the ideologies and methodologies of politics and of economics, in short, the history of the growth of ideas and feelings, of the changes of thinking, the alterations of concepts which have come to pass during historical times. If one knew this story one would not only be more tolerant of alleged new concepts when they are broached but he would frequently see in them the recurrence of ideas that have long ago played their part upon the stage and then supposedly made their exit.

I was brought up in an absolutistic, rigid world, in which the laws of cause and effect and the indestructibility of matter reigned supreme and in which psychology was called "moral philosophy." These self-imposed limitations are now being questioned and psychology has become a biological science and whatever the results we must stand by them, and do so with the realization that another step has been taken in an understanding of the world in which we live and of ourselves. The frontiers of knowledge are ever advancing over what for most of the people at any given time are impossible barriers. The educational process is not merely a matter of lecturing to a class, or of giving lessons in books and the holding of examinations for the purpose of determining what the student can remember. It is much more a process in the field of the psychology of interpersonal relations. Is it not possible out of all we know to begin to plan a curriculum that will help to preserve the plasticity of the mind? Not only in teaching to tell of things as they are but to tell the fascinating story of how they came to be what they are? There are regions of knowledge, or perhaps I should say fields of research, that have never been tapped for this purpose. Time does not permit me to discuss this recommendation or to elaborate by making additional ones. I merely want to say that I have made this single recommendation, which may seem inappropriate, for the reason that in our work in psychiatry it has been demonstrated that a review of the historical aspects of a given pathological situation may be curative. Is it too much to ask this question and too much to expect results from its answer?

(Please turn to page 48)



ELMER J. LUND

ELMER J. LUND

The newly elected member of the Executive Committee of Sigma Xi was born in Springfield, Minnesota, in 1884. He received his bachelor's degree from Hamline in 1910 and from 1911 to 1914 was Bruce Fellow at Johns Hopkins, where he was awarded his Ph.D. in 1914. He has served as instructor in zoology at the University of Pennsylvania, assistant and associate professor at the University of Minnesota, and since 1926 has been professor of zoology (physiology) at the University of Texas. He is a member of Phi Beta Kappa and of Sigma Xi, and of many scientific societies, and has contributed more than sixty articles to American and foreign journals dealing mainly with cell physiology, organic polarity, cell correlation and the origins and functions of bio-electric currents in plants and animals.

CHARGE TO THE GRADUATING CLASS OF GEORGE WASHINGTON UNIVERSITY, FEBRUARY 22, 1937*

CLOYD H. MARVIN

Members of the Winter Graduating Class of 1937:

You go forth into a world that actively bids for you to believe in collectivism—collectivism as we have seen it in its modern forms leads to totalitarianism and personal rule. A dominated crowd is never creative. A dominated crowd cannot last, for such direction demands that the hearts of men be sacrificed.

With your ability, training and background you have no call to make such sacrifice; rather should you create your own several worlds.

What each brings to the world he is creating, that will be his world. In answer to smiles will be brought joy; to the open mind will be yielded knowledge; to worth will be returned treasure; to work will be given strength; to honesty will come acceptance by fellow men; to faith will come dreams answered; and to love is entrusted life itself.

Your university bids you go forth into your world and so live that your integrity will guarantee to the minds of men the principles of freedom and of living which you espouse.

May the Lord God of Hosts bless you.

* This charge was given at George Washington University on the occasion of the Mid-winter Convocation, of which the installation of the George Washington Chapter was a feature. It is reproduced because of its timeliness.—Ed.

MINUTES OF THE MEETING OF THE EXECUTIVE COMMITTEE OF SIGMA XI, ATLANTIC CITY, N. J., DECEMBER 29, 1936

The second meeting of the Executive Committee for 1936 was held in the Hotel Haddon Hall, Atlantic City, December 29, 1936. Those present were President Durand, Secretary Ellery, Professor Stadler, Professor Miller, Professor Parker, and Doctor Knight. Business was transacted as follows:

1. FORMAL PRINTED PETITIONS FOR A CHARTER FOR A CHAPTER.

At the meeting of the Executive Committee held in Ithaca June 18, 1936, official visitors appointed to make a survey of the equipment and resources and research output at certain institutions made their reports. Acting upon the reports, as well as upon opinion of conditions at the institutions expressed by various members of the Committee, it was voted that the petitioners at the different institutions should present a formal printed petition for consideration of the Committee at the December meeting.

The Secretary presented printed petitions from:

- a. George Washington University.
- b. Carnegie Institute of Technology.
- c. University of Utah.
- d. State College of Oregon.

The secretary further reported that the printed petitions had been distributed among the chapters in accordance with instructions from the Executive Committee, on November 5, 1936, and that the chapters had been informed that the petitions would probably come before the 37th Convention. It was

VOTED: That the formal printed petitions from these four institutions should be presented to the 37th Annual Convention of the Society with the recommendation of the Executive Committee for favorable action.

2. REPORTS OF OFFICIAL VISITORS.

At the meeting of the Committee held in Ithaca June 18, 1936, the President was authorized to appoint official visitors to make survey of the equipment and resources and research output of Rice Institute and Massachusetts State College, for report at the December meeting. Subsequent to the June meeting President Durand appointed Professor Parker as the official visitor to Massachusetts State College, and agreed to act himself as the official visitor to Rice Institute.

Typed reports of the findings of these official visitors were presented to the Committee for consideration. It was

VOTED: That these reports be manifolded, and a copy sent to each member of the Committee one month prior to the spring meeting. It was further

MINUTES OF MEETING OF EXECUTIVE COMMITTEE 27

VOTED: That consideration of these reports be made a special order of business at the spring meeting.

3. PRELIMINARY INFORMATION REGARDING INSTITUTIONS.

At the meeting of the Committee in Ithaca June 18, 1936, preliminary information about the science equipment and resources and research work in progress at Wellesley College and at Radcliffe College was presented for consideration. The Secretary was instructed to have the information manifolded and distributed to the members of the Committee one month prior to the December meeting. As a result of the study of the information thus made possible, it was

VOTED: That the President be authorized to appoint official visitors to make survey of the conditions at Wellesley College and at Radcliffe College, for report at the spring meeting. (Following the meeting the President named Prof. George A. Baitzell, Yale University, and Secretary Ellery as the official visitors to these institutions.)

4. ADDITIONAL INFORMATION FROM INSTITUTIONS ALREADY UNDER CONSIDERATION.

a. *University of Alabama.*

At the meeting of the Committee held in Ithaca June 18, 1936, the Secretary reported that information regarding this institution was first presented to the Committee in 1932. Additional information gave account of recent progress in research at the University, and further consideration on the part of the Committee was requested. The Committee decided not to take definite action at the time, and instructed the Secretary to make inquiry regarding the financial conditions of the institution.

The Secretary reported what he had learned in response to that action, and it was

VOTED: That the University of Alabama be made a special order of business at the April meeting.

b. *University of Georgia.*

Previous action of the Committee in the case of this institution is similar to that at the University of Alabama. It was

VOTED: That the University of Georgia be made a special order of business at the April meeting.

c. *Virginia Polytechnic Institute.*

At the April, 1935, meeting of the Executive Committee information about the Virginia Polytechnic Institute in addition to that which had already been presented and considered, was submitted for study by the Committee. The Committee felt that no action on a possible petition should be taken at the time, and instructed the Secretary to obtain the report of the Committee on Engineering Education regarding the engineering work done at the Institute. The Secretary reported that this Committee had not visited the Virginia Polytechnic Institute, and submitted letters from prominent engineers. It was

VOTED: That the Virginia Polytechnic Institute be made a special order of business at the April meeting.

d. West Virginia University.

Information about this institution has been under consideration by the Executive Committee for a number of years. The Secretary presented new information which had reached him just prior to this December meeting. It was

VOTED: That the recent information about the equipment and resources and research work in progress at the University of West Virginia be manifolded and sent to the members of the Committee one month prior to the spring meeting.

It was further

VOTED: That the West Virginia University be made a special order of business at the April meeting.

e. University of Florida.

The Secretary reported that he had received on the morning of the day of the meeting additional information about the equipment and resources and progress of the University of Florida. It was

VOTED: That action be postponed, and that a special report in this institution be made to the Committee at its spring meeting.

f. Lawrence College.

The Secretary reported that he had received just prior to the meeting of the Committee detailed information about the organization and resources and research work in progress at Lawrence College in Appleton, Wisconsin, in conjunction with the work of the Institute of Paper Chemistry, which is associated with that college. It was

VOTED: That the information about Lawrence College be manifolded and distributed to the members of the Committee one month prior to the April meeting.

It was further

VOTED: That Lawrence College be made a special order of business at the spring meeting.

5. SCIENCES RECOGNIZED BY SIGMA XI.

The Secretary reported that in accordance with the action taken by the Committee at its meeting in Ithaca June 18, 1936, he had called the attention of all the chapters to the list of sciences officially recognized by Sigma Xi at the 1929 Convention. In this connection the Secretary presented a letter from the secretary of the Minnesota Chapter asking a ruling in the case of a professor in the Division of Agricultural Economics, University Farm, St. Paul, Minnesota. He was elected as a member of Sigma Xi by the

MINUTES OF MEETING OF EXECUTIVE COMMITTEE 29

Cornell Chapter in 1928 from the field of social sciences. The professor asked what his status in the Society is in view of the action of the Convention of 1929. It was

VOTED: That the Secretary be instructed to inform both the secretary of the Minnesota Chapter and the professor himself that in the view of the Executive Committee the professor is a *bona fide* member of Sigma Xi, and that the action of the 1929 Convention in limiting the fields of science recognized by Sigma Xi did not change his status.

6. ELIGIBILITY OF GRADUATES TO ASSOCIATESHIP.

The Secretary presented correspondence with the chapter at the University of Washington regarding the possible postponement of election as associates of senior students until after graduation. The specific question raised by this chapter is stated as follows: "Occasionally the nomination of a senior student is not acted upon by the nomination committee, as they wish for more information concerning the candidate. When this occurs the nomination is held over for one year. If the student becomes a graduate student in the institution, the situation may be cleared to the satisfaction of the Nominating Committee. If the student leaves for a position elsewhere, the Nominating Committee is of the opinion that a period of five years must elapse before he may be considered again (National Constitution, Article III, Section 6 a)."

After considerable discussion of the situation, in which all the members of the Committee participated, it was

VOTED: That the Secretary be instructed to inform the University of Washington Chapter that in the view of the Executive Committee the Constitution defines clearly eligibility of alumni members (Article III, Section 6 a), and that a graduate of an institution who is not connected with the institution is eligible to election as an alumnus member only after five years' standing if he has shown within that period noteworthy achievement as an original investigator in some branch of pure or applied science; and that the fact that a student may have been under consideration for election, but failed of election, while still an undergraduate, does not affect the definition of eligibility after graduation.

7. COMMITTEE ON LECTURES AND PUBLICATIONS.

(The report is given in full on page 49.)

8. SEMI-CENTENNIAL RESEARCH PRIZES.

The Secretary presented a request from one of the chapters that the names of all the candidates for a Sigma Xi Semi-centennial research prize be published in the official journal of the Society. The question was referred to the Committee of Award of the Semi-centennial research prizes, and the chairman of the committee, Prof. Harold C. Urey, reported that it was the unanimous opinion of the Committee of Award that no useful purpose would be served by the publication of the complete list of candidates, and that the committee advised against its publication.

9. COMMITTEE ON THE SOCIETY'S POLICY.

At the meeting of the Executive Committee in Ithaca June 18, 1936, the question was raised as to possible future use of the income from invested funds of the Society in the years to come. Discussion of the question brought out the fact that the continually expanding work and resources of Sigma Xi required an intensive study of the policies of the Society along all lines. As a result of the discussion the President was authorized to appoint a committee on policy, to study the activities of the Society and to make recommendations regarding all phases of the Society's work. The President announced the following committee: Professor Gortner, chairman, Professors Leuschner and Miller, representing the Executive Committee; Professors Parker and Baitzell, representing past officers of the Society; Mr. Davies and Mr. Norton, representing the alumni.

The Secretary was instructed to communicate with the chairman of the committee, suggesting possible questions for the committee to consider, and requesting that the committee be prepared to make a preliminary report at the spring meeting of the Executive Committee.

10. REPORT OF OFFICERS.

The reports of the President, Secretary and Treasurer were submitted to the Executive Committee prior to presentation to the Convention. These reports appear in full in this issue of the *QUARTERLY*. In connection with the Treasurer's report, it was

VOTED: To present to the Convention with recommendation for favorable action the following resolutions:

RESOLVED: That the annual assessment on each chapter for 1937 shall be payable on January 1, 1937, and that the amount of the assessment on each chapter shall be 75 cents multiplied by the number of members and associates of the chapter on January 1, 1937.

RESOLVED FURTHER: That in sending notice of the 1937 assessment to chapter treasurers, the Treasurer of the Society be instructed to advise each chapter that the assessment is to be computed strictly on the basis of the number of members and associates on the membership roll of the chapter, without regard to whether said members have or have not paid current chapter dues, and to explain that this method of fixing the amount of the assessment on each chapter has been adopted by the conventions of the Society as the most equitable to all chapters.

11. FILING CABINET FOR THE SECRETARY'S OFFICE.

The Secretary reported that the filing cabinets now in his office were inadequate for a complete filing of the more than 40,000 addressograph stencils of members and associates, and requested authorization to purchase an additional cabinet. It was

VOTED: That the Secretary be authorized to purchase a cabinet for filing addressograph stencils.

MINUTES OF MEETING OF EXECUTIVE COMMITTEE 31

12. UNIFORM STATIONERY FOR CHAPTER USE.

The Secretary reported that from time to time requests reached his office from various chapters for a supply of Sigma Xi stationery bearing the official seal of the Society, and asked whether in the opinion of the Committee it might be well to include in the official announcements of material available to chapters from the Secretary's office, appearing on the last page of each issue of the QUARTERLY, a statement that such stationery is available for all chapters. It was

VOTED: To authorize the Secretary to add to announcements appearing in the QUARTERLY a statement that official stationery, sheets and envelopes, are available for all chapters desiring them at the actual cost of embossing.

13. SPRING MEETING OF THE COMMITTEE.

After considerable discussion regarding the most convenient date for the stated spring meeting of the Executive Committee, it was

VOTED: That the spring meeting of the Executive Committee be called for Wednesday, April 28, at 2.30 at the Cosmos Club in Washington, D. C., and that members of the Committee who were not present should be canvassed regarding the convenience for them of that time and place of meeting.

14. THE 38TH ANNUAL CONVENTION.

The Secretary called the attention of the Committee to the fact that it was customary to begin early in each calendar year the consideration of the annual lecturer at the joint meeting of the Society and the A. A. A. S. at the December meetings. The Secretary was asked to request the Executive Committee at an early date to recommend for the consideration of the President possible lecturers for the 38th Annual Convention.

15. ADJOURNMENT.

The meeting was adjourned at 4.00 P.M.

EDWARD ELLERY, *Secretary.*

THE THIRTY-SEVENTH CONVENTION

The 37th Convention of the Society of the Sigma Xi was held in Hotel Haddon Hall, Atlantic City, New Jersey, December 29, 1936.

1. CALL TO ORDER.

The business session was called to order at 4.00 P.M. by the President, Dr. W. F. Durand of Stanford University.

2. COMMITTEE ON CREDENTIALS.

President Durand announced a committee on credentials as follows:

E. R. Hedrick, University of California at Los Angeles, chairman.

J. H. Yoe, University of Virginia.

J. R. Lewis, University of Utah.

3. REPORT OF COMMITTEE ON CREDENTIALS.

The committee received the credentials of the delegates and reported that forty-six chapters and seven clubs were represented as follows:

a. Chapters represented by delegates present:

Cornell	Purdue	Maryland
Rensselaer	Washington University	Kansas State
Union	District of Columbia	Pennsylvania State
Kansas	Texas	Oklahoma
Yale	Mayo Foundation	State Collge of Wash-
Nebraska	Rutgers	ington
Pennsylvania	McGill	Wyoming
Iowa	Kentucky	Pittsburgh
Stanford	Idaho	Harvard
Columbia	Swarthmore	Princeton
Chicago	Oregon	Duke
Illinois	Virginia	California at Los Angeles
Case	New York	Tulane
Syracuse	Cincinnati	Smith
Wisconsin	Michigan State	Carleton
Worcester	Lehigh	

b. Chapters which had reported appointment of delegates but were not represented:

Ohio	Rochester	Western Reserve
North Carolina		

c. Chapters which had not reported appointment of delegates and were not represented:

Minnesota	University of Washing-	College of Medicine,
Brown	ton	University of Illinois
California	North Dakota	Massachusetts Institute
Michigan	Iowa State	of Technology
Indiana	Johns Hopkins	Wesleyan
Missouri	California Institute of	Buffalo
Colorado	Technology	
Northwestern	Arizona	

d. Clubs represented:

Oregon State College	Virginia Polytechnic	Massachusetts State
University of Florida	Institute	College
University of Utah		Lewis Institute

e. Officers present.

President Durand, Secretary Ellery, Professor Stadler, Professor Miller, Professor Parker, Doctor Knight.

The Secretary appends to the report of the Committee on Credentials the following record of attendance at the last five conventions:

	<i>Chapters present and voting</i>	<i>Total number chapters</i>	<i>Clubs present</i>	<i>Total number of Clubs</i>
1931	43	58	12	28
1932	32	60	9	32
1933	34	62	6	31
1934	46	64	6	32
1935	52	66	12	36
1936	46	68	7	34

4. MINUTES OF THE 36TH CONVENTION.

The account of the proceedings of the 36th Convention of the Society held in St. Louis, December 31, 1935, as published in the March QUARTERLY for 1936, was approved as printed.

5. REPORT OF THE PRESIDENT.

(This report appears in full, page 38.)

6. REPORT OF THE SECRETARY.

(This report appears in full, page 42.)

7. REPORT OF THE TREASURER.

(This report appears in full, page 45.)

Following the Convention, the President named J. T. Finneran and Frank X. Farr as auditors, and their report accompanies the Treasurer's report.

8. ASSESSMENT FOR 1937.

In accordance with the usual procedure and policy of the Convention, and upon the recommendation of the Executive Committee, the following resolutions were adopted:

RESOLVED: That the annual assessment on each chapter for 1937 shall be payable on January 1, 1937, and that the amount of the assessment on each chapter shall be 75 cents multiplied by the number of members and associates of the chapter on January 1, 1937.

RESOLVED FURTHER: That in sending notice of the 1937 assessment to chapter treasurers, the Treasurer of the Society be instructed to advise each chapter that the assessment is to be computed strictly on the basis of the number of members and associates on the membership roll of the chapter, without regard to whether said members have or have not paid current chapter dues, and to explain that this method of fixing the amount of the assessment on each chapter has been adopted by the conventions of the Society as the most equitable to all chapters.

9. GRANTS-IN-AID OF RESEARCH.

(See President's report.)

10. CERTIFICATES IN COMMENDATION OF RESEARCH.

(See President's report.)

The engrossed certificates were on exhibition during the Convention.

11. PETITIONS FOR CHARTERS FOR CHAPTERS.

The Executive Committee presented to the Convention formal printed petitions for charters for chapters from

- a. George Washington University.
- b. Carnegie Institute of Technology.
- c. University of Utah.
- d. State College of Oregon.

Each petition was presented individually to the Convention, with a statement from the President as to the procedure followed in each instance prior to the preparation and presentation of a formal printed petition. It was further announced that the printed petitions had been distributed to the chapters by the Secretary on November 5. Each petition was presented to the Convention by the Executive Committee with a recommendation for favorable action.

The Convention voted unanimously in the case of each petition in favor of granting the petition for a charter.

12. AMENDMENTS TO THE CONSTITUTION.

In the September, 1936, issue of the *QUARTERLY* there appeared in full suggested amendments to the national Convention, and chapters were asked to be prepared to take action at the Convention scheduled for December 29, 1936. Doctor Knight for the Alumni Committee explained why the amendments were proposed, and the national Secretary showed how the amendments brought Sigma Xi clubs into official connection with the national organization. All of the proposed amendments were adopted unanimously as follows:

a. Article II, Section 2.

Present reading :

A petition for a charter for the establishment of a new chapter shall be communicated to the President of the Society who shall refer it to the Executive Committee for consideration. When the petition is reported by the Committee, a three-fourths vote of the Convention shall be necessary for granting a charter.

Adopted reading :

A petition for a charter for the establishment of a new chapter shall be communicated to the President of the Society, who shall refer it to the Executive Committee for consideration. If the Executive Committee presents the petition to the Convention with recommendation to favorable action a charter may be granted by a three-fourths vote of the Convention.

b. A new article, numbered "Article III," is added as follows:

Article III, Section 1.

A Sigma Xi alumni club composed of local alumni members and alumni associates of the Society may be organized at any place to engage in activities to further the objects of the Society. The recognition of such a local organization as a Sigma Xi club shall require favorable action by the Executive Committee of the Society, and the Executive Committee shall have power to withdraw recognition of any club.

(Adoption of this amendment involves a change in the numbering of all articles following this article.)

c. Article VIII, Sections 1 and 2.

Present reading :

ARTICLE VIII

CONVENTIONS

SECTION 1. A regular Convention of the Society, consisting of delegates from each chapter and from the alumni members of the Society, shall be held annually at such time and place as shall be determined by the Executive Committee and due notice shall be given to each chapter and to alumni members through the official journal of the Society.

SECTION 2. Delegates. (a) Each chapter in good standing shall be entitled to a representation of not more than three delegates at each Convention. The members of the Alumni Committee shall *ex-officio* be the delegates representing the alumni members of the Society.

(b) The delegates representing any chapter shall be chosen from its chapter members; except that in case any chapter shall be unable to send its own members, it may appoint members of any other chapter as its representatives.

(c) In Convention each chapter represented and each member of the Alumni Committee shall have one vote.

Adopted reading :

SECTION 1. A regular Convention of the Society shall be held annually at such time and place as shall be determined by the Executive Committee, and due notice shall be given to each chapter, to each club, and to alumni members through the official journal of the Society.

SECTION 2. Delegates. a. Each chapter in good standing shall be entitled to a representation of not more than three delegates at each Convention. The members of the Alumni Committee shall *ex-officio* be delegates representing alumni members of the Society. b. No change. c. No change. Section d is added as follows :

Each alumni club shall be entitled to have not more than three delegates attend any Convention. A club delegate shall have the privilege of the floor, to discuss any subject before the Convention. Delegates of alumni clubs shall be entitled to vote only on questions directly affecting alumni members and associates. On such questions each club shall be entitled to one vote.

d. Article IX, Section 2.

Present reading :

SECTION 2. Alumni members and associates shall contribute to the support of the Society in such ways as may be agreed upon by the Executive Committee or the Alumni Committee. All sums so collected shall be separately accounted by the Treasurer of the Society and shall be known as the Alumni Fund.

Adopted reading :

Alumni members and associates, including those organized in clubs, shall contribute to the support of the Society in such ways as may be agreed upon by the Alumni Committee and the Executive Committee. All sums so collected shall be separately accounted by the Treasurer of the Society, and shall be known as the Alumni Fund.

13. ELECTION OF OFFICERS.

The Convention was called upon to choose a member of the Executive Committee for the ensuing five years to succeed Dr. Henry V. Wilson, whose term of office expired in 1936; and a member of the Alumni Committee to succeed Dr. Henry G. Knight, whose term of office expired in 1936. The President announced that he had named as a nominating committee: Prof. B. F. Kingsbury of Cornell as chairman; Prof. W. L. Upson, Washington University, and Prof. Ralph W. Chaney, University of California at Berkeley. The committee reported as follows :

For member of the Executive Committee for the ensuing five years, Prof. E. J. Lund of the University of Texas ;

For member of the Alumni Committee for the ensuing five years, Dr. Henry G. Knight, chief of the Bureau of Chemistry and Soils, U. S. Department of Agriculture.

It was moved and carried that the Secretary be authorized to cast a ballot for the officers named by the nominating committee. The Secretary cast the ballot and the President announced the officers elected as named.

14. MEMBERS AFFILIATED WITH CHAPTERS.

A delegate from the Kentucky Chapter asked for a ruling on the question of the status of members and associates of Sigma Xi who desired to affiliate themselves with a nearby chapter, but who had not been originally elected into the Society by that chapter. In answer to the question the President called attention to Article III, Section 2 of the national Constitution, defining membership of chapters, which states that alumni members and associates of the Society who become affiliated with chapters have all the duties and privileges of chapter members and associates of the chapter with which they are affiliated, except voting.

15. ANNOUNCEMENT OF THE 15TH ANNUAL SIGMA XI LECTURE.

The President announced that the 15th annual Sigma Xi lecture, given under the joint auspices of the A. A. A. S. and of the Society, would be given in the Municipal Auditorium at 8.15 by Dr. Henry G. Knight, chief of the United States Bureau of Chemistry and Soils, on the subject of "Selenium and Its Relation in the Soil to Animals and Plants and Public Health." (The lecture is the leading article in this issue of the *QUARTERLY*.)

16. ADJOURNMENT.

The Convention adjourned at 5.50 P.M.

EDWARD ELLERY, *Secretary*.

REPORT OF THE PRESIDENT FOR 1936

1. THE SEMI-CENTENNIAL.

Obviously the important event in the annals of the Society for the year 1936 was the celebration of the Semi-centennial at Ithaca. The central committee of arrangements was responsible for the program, and the Alpha Chapter carried it out to perfection, even to the minutest details. The number present exceeded all expectations. The various committees of arrangements estimated before the event that there might be 150-200 delegates and guests. Something over 700 were present throughout most of the program.

A significant part of the Semi-centennial program was the award of the first Sigma Xi research prizes of \$1,000 each—one to Dr. I. I. Rabi of Columbia University in the physical sciences, and one to Dr. Richard E. Shope of the Rockefeller Institute in the biological sciences.

A memorial tablet commemorating the occasion was erected in front of Sibley Hall, the building in which tradition states the Society was founded. The trustees of Cornell provided for the tablet a base of Indiana limestone, and the Society presented the bronze tablet.

The addresses delivered on the occasion appear in full in the Semi-centennial number of the *QUARTERLY*. There are a few copies here for the benefit of those who may not have seen it.

2. NEW CHAPTERS.

During the year chapters were installed at Carleton College on April 22, and at the University of Buffalo on April 25. This brings the total number of chapters to sixty-eight.

3. The Executive Committee will present to you for consideration later at this Convention petitions for charters for chapters from George Washington University, Carnegie Institute of Technology, the University of Utah, and the State College of Oregon.

4. INSTITUTIONS UNDER CONSIDERATION.

- a. During the year official visitors made surveys of the resources and equipment and research output at Rice Institute and at Massachusetts State College. The Executive Committee is considering at this time the reports from these visitors, and may have something definite to say about them at the next Convention.
- b. Preliminary information about resources and equipment and research work at Wellesley College and at Radcliffe College is being carefully studied, and there are four institutions which have been under consideration by the Executive Committee for a number of years, but about which the Committee is not yet prepared to take definite action.

5. CERTIFICATES IN COMMENDATION OF RESEARCH.

Five years ago the Convention authorized the Executive Committee to award certificates in commendation of research done in institutions where

there is no chapter of Sigma Xi. The awards for 1936 represent the fourth of the series. The committee of award this year was headed by Prof. Paul Kirkpatrick of Stanford University, assisted by the following members of the scientific faculties of that university:

P. J. Beard	E. L. Grant	R. A. Ogg
F. W. Bergstrom	W. B. Kindy	G. M. Smith
L. R. Blinks	J. E. Markee	F. E. Terman
L. L. Burlingame	W. H. Manwaring	D. M. Whitaker
P. C. Cross	A. W. Meyers	I. L. Wiggins
G. F. Ferris	S. B. Morris	H. A. Williams
John Field		

The theses submitted were limited to the fields of physics, chemistry and biology. There were sixteen candidates from seven institutions, and ten awards were made as follows:

Polytechnic Institute of Brooklyn.

Coyne, Thomas Denis—The Effect on the Endurance Limit of Submerging Fatigue Specimens in a Cold Chamber.

Happe, William Henry, Jr.—An Investigation into the Methods of Measuring the Power Factor of Solid Dielectrics at Radio Frequency.

Struthers, James D.—A Study of the Reaction Between Ferric Oxide and Barium Oxide, Barium Hydroxide, and Barium Carbonate.

Louisiana State University.

Anderson, Robbin Colyer—A Study of a Termolecular Reaction in Solution.

Smith, Joseph Davis—The Leguminosae of Rapides Parish.

Oregon State Agricultural College.

Miller, William Alphonso—A New Micro Wave Generator.

University of Vermont.

Ludwig, Bernard John—The Preparation of Certain Diguanidines of Possible Physiological Significance: 1. Sulfur-containing Diguanidines; 2. An Isomer of Neosynthalin.

Massachusetts State College.

Clancy, Carl Francis—A Study of *Brucella Abortus* in Relation to Phagocytosis with Reference to Strain Variation and Activities of Culture Filtrates Against Leucocytes.

Whaley, W. Gordon—A Study of Certain Mendelian Factors in *Tropaeolum*.

University of Utah.

Weight, Jay William—The Reduction of Harmonic Distortion in Amplifiers by Negative Feedback.

The certificates are on exhibition here for the scrutiny of the delegates.

6. GRANTS-IN-AID OF RESEARCH.

Since 1921, with the exception of one year, the Society has been distributing on the average about \$2,000 annually in the form of grants-in-aid of research. That policy was continued during the current year. Grants were made as follows:

- C. W. Briggs, assistant professor of biology, Dillard University, New Orleans, \$250 for work on the biochemistry and physiology of medusae.
- Tze-Tuan Chen, Sterling research fellow, Yale University, \$150 for work on "The Physical Basis of Heredity in Unicellular Organism."
- Calvin Springer Hall, Jr., assistant professor of psychology, University of Oregon, \$200 for work on "The Inheritance of Emotionality."
- George William Hunter, 3rd, assistant professor of biology, Wesleyan University, Middletown, Conn., \$300 for work in "The Reaction of Host to the Penetration of Various Parasitic Worms."
- Hubert M. James, assistant professor of physics, Purdue University, \$230 for work on "Wave Mechanical Computation of Molecular Forces and Computation of Nuclear Wave Functions."
- Donald B. Lawrence, student in plant physiology, Johns Hopkins University, \$300 for "Studies on the Submerged Forest on the Columbia River."
- Donald H. Menzel, assistant professor of astronomy, Harvard University, \$150 for a rapid galvanometer to make possible high precision in the study of the spectrograms obtained on the Siberian eclipse expedition.
- Joseph Valasek, associate professor of physics, University of Minnesota, \$300 for completing a normal incidence vacuum spectrograph in a study of absorption and fluorescence spectra of gases in the far ultra-violet.

The committee of award consists of W. R. Whitney, chairman, Harlow Shapley, and Gary N. Calkins.

7. SCIENCES WHICH SIGMA XI REPRESENTS.

In 1928 the Executive Committee voted to limit the fields of science recognized by the Society to the following: mathematics, physics, chemistry, astronomy, sciences of the earth, biology in its various branches including psychology, anthropology, medicine in its various branches, engineering in its various branches. That action was confirmed by the Convention of 1929. During the year it has been reported to the Committee that not all chapters were limiting their elections in accordance with this action of the Executive Committee and the Convention, and the Committee voted to call the attention of the chapters to this action in the fall of each year.

8. THE COMMITTEE ON POLICY.

The increase in the permanent funds of the Society brings up the question as to what will be the best policy in the coming years in the use of the income. In fact, the time has come when the entire policy of the Society in all the phases of its work must be given very careful study. We are no longer a young Society, struggling for existence. We are a great Society, with a very definite position, and exerting a widespread influence in science circles. In view of this, the Executive Committee authorized your President to appoint a committee on policy, whose function will be to study the internal conditions of the Society, its position in the scientific world, and the ways in which it can serve best its purpose in the promotion of research. Acting upon such authority, the President has appointed the following as the committee:

Doctor Gortner, chairman, Doctor Parker, Doctor Leuschner, Doctor Miller, Doctor Baitsell, Mr. Davies and Mr. Norton.

It will be easily seen that this committee has a large work before it, and all chapters and clubs are earnestly and seriously urged to make suggestions to this committee either directly, or through the office of the National Secretary. It is hoped that something definite about the future policy of Sigma Xi may be presented to the 38th Convention.

9. AMENDMENTS TO THE CONSTITUTION.

In the September issue of the *QUARTERLY* there were published suggested amendments to the Constitution. These concern largely the relation of Sigma Xi clubs to the national organization. At present there are thirty-four such clubs, but they have no official status in the national organization, since the present Constitution adopted at the Boston Convention in 1922 made no provision for the organization of Sigma Xi clubs. At present clubs consist of those members of an institutional staff who are already members and associates of Sigma Xi, or of groups of Sigma Xi members and associates who have voluntarily banded themselves together in cities. Many of them do an important work, sponsoring science meetings in their institutions, fostering research work on the part of their students, and inspiring their students to pursue graduate work in science in universities. They make reports of their activities to the Secretary's office, and they are invited by the Executive Committee to send representatives to the annual conventions. All of this is extra-constitutional. The Executive Committee now proposes to amend the Constitution in such way that these clubs will have a certain definite official association with the national organization. Your chapters have been asked in the *QUARTERLY* to study these amendments in preparation for possible action at this Convention. A full discussion is hoped for. The question of the connection of the clubs with the national organization is an important one.

W. F. DURAND, *President*.

REPORT OF THE SECRETARY FOR 1936

The work of the Secretary's office for 1936 can be summed up in a few words, but it could not have been done in a few weeks or a few months. In fact, it is not done yet, but the end is in sight.

First, for the sake of comparison, let me repeat a paragraph from the Secretary's report for 1935, listing the normal year's work done by your Secretary.

"The demands on the Secretary's office increase as the activities of the Society expand. Formerly these activities were limited to chapter business and the QUARTERLY. To these has been added: (1) the control by the Society of the sale of its insignia (1,275 orders during 1935), each one of which is acknowledged to the purchaser at the time the order is sent the official jeweler; (2) the alumni movement—once a year a letter is sent to every one of the 15,000 and more members and associates who are not connected with a chapter; (3) the grants-in-aid of research—entailing correspondence with intending applicants; (4) the certificates in commendation of research, awarded to students for work in science in institutions where the Society has no chapter—again involving a great deal of correspondence.

It is to be expected that in a Semi-centennial year of a great Society like ours with a proper celebration of that important occasion to arrange for and carry out, with an adequate report of it in a permanent form, and with the preparation of a fifty-year history, an immense amount of labor is involved, which naturally falls upon the Secretary's office—the place where details of the Society's management are available and records are on file.

Let me tell you a little about the unusual demands on the Secretary in 1936.

1. CIRCULARIZING THE MEMBERSHIP.

Since 1921 only those members and associates who are not connected with chapters have been invited to contribute to the so-called "Alumni Research Fund." At the beginning of the movement approximately 10,000 circular letters were issued. A year ago the number had grown to approximately 18,000. As a fitting part of the celebration of our Semi-centennial, the Executive Committee voted to raise \$50,000 and to call it the Semi-centennial Endowment Fund. It was further voted that every member and associate, whether connected with a chapter or not, should be invited to contribute. This meant something like 40,000 letters.

2. CORRECTING THE ADDRESS LIST.

Before issuing the circular letter to the members and associates, it was obviously necessary to secure their correct addresses. Chapter secretaries and alumni recorders at the institutions where Sigma Xi has chapters were asked to cooperate with the Secretary in that enormous piece of work. What we did was to type from the record cards on file in our office a

complete list of the individuals elected by the chapters, which was sent to someone connected with the institution who could supply the last known address. That meant typing 40,000 names.

It meant more than that! It meant oft-repeated appeals to some of those to whom the lists were originally submitted to return them to us corrected. In many instances the Society quite properly paid for the service thus rendered. The corrected addresses were then transferred to the record cards of the Secretary's office—that means two cards (one for chapter file and one for alphabetical file) and one addressograph stencil for each individual. Totals, 80,000 cards and 40,000 stencils were handled.

After the correct addresses had been received and recorded, the 40,000 circular letters were addressed and issued.

3. THE SEMI-CENTENNIAL HISTORY AND RECORD.

a. *The History of the Society.*

The history of the first quarter century was amply and ably covered by Prof. Henry B. Ward, and was given permanent form in the Quarter Century Record and History published in 1911. The history of the second quarter century of the Society records the growth of the organization and the expansion of its activities since 1911 and was prepared by your present Secretary.

b. *Chapter and Club Histories.*

Chapter histories were prepared by chapter historians especially appointed for the task by the chapters. There were sixty-six chapter historians to contribute that material. Sigma Xi clubs have come into existence since 1911, and they form an important and active and interested part of the Society. Hence club histories also appear in the Semi-centennial History and Record. The secretaries of our thirty-three clubs were asked to provide those histories. Something like 100 different individuals had to be depended upon for all this information. In the main, the response has been prompt and cheerful. First requests for these histories went out in January. Requests were repeated in subsequent months where necessary. Any of you who have had to deal with 100 busy individuals will not be surprised when your Secretary reports that the last of the chapter histories reached his office in October.

c. *Chapter Rolls and Alphabetical List.*

Obviously these had to be prepared for the printer from the record cards of the Secretary's office. That involved typing two more lists of 40,000 names each.

It will be seen that we have typed three separate lists of 40,000 names each—one to get correct addresses, one for chapter enrollment and one for alphabetical arrangement as they appear in the Semi-centennial History.

d. *The Hobby List.*

An innovation in the Semi-centennial History is a list of the hobbies of members and associates so far as they have been reported to the Secre-

tary. Already, in advance of publication, requests have come in for names and addresses of individuals who have developed hobbies in particular fields. We have fortunately been able to supply the information.

Copy for the history is now all in the hands of the printer. Galley proof has been read. To date (December 18) page proof has been corrected up to page 720. The volume will number about 1,500 pages, and it is hoped to issue by the end of January.

4. REPORT OF THE SEMI-CENTENNIAL CELEBRATION.

Naturally the full story of that event had to be reported in permanent form. Time and effort were required to accomplish this. The so-called June issue of the *QUARTERLY* (which was not in the mails until August) gives the complete account of the program, accompanied by a few appropriate pictures. Copies of the issue are available from the Secretary for any who may not have seen it.

5. THE GEOGRAPHICAL FILE OF MEMBERS AND ASSOCIATES.

The Secretary receives constant requests for names and addresses of Sigma Xi members and associates resident in particular areas. While such a list is not to be printed, the record is to be kept available in the Secretary's office. We are now at the work of completing that file. Beginning with Maine, and proceeding west, we have done twenty-seven of the forty-eight states, and are now on Kentucky.

(Since the Convention, this file has been completed, and lists supplied enquirers in four different regions.)

6. THE NORMAL SCHEDULE OF THE SECRETARY'S OFFICE.

You will all see how the normal work of the Secretary's office has been thrown off its schedule in 1936. You will understand why the September issue of the *QUARTERLY* was not in the mails till November, and why the December issue appeared only a week or two ago. There has been an avalanche of work, but your Secretary is not yet overwhelmed. He is almost up to date now in conducting the business of our great Society, and expects he will not be thrown off schedule again until the celebration of our 75th anniversary in 1961.

EDWARD ELLERY, *Secretary.*

REPORT OF TREASURER FOR 1936

The 1936 assessments of all chapters, except the Cornell University Chapter, were paid within the year. (The Cornell Chapter paid just after the end of the fiscal year.)

RECEIPTS

Cash on hand, December 31, 1935.....	\$11,045.85
Chapter assessments for 1936.....	7,109.80
Chapter assessments for 1935, arrears.....	411.00
Chapter assessments for 1937, advance.....	24.75
Initiation fees for 1936.....	2,444.30
Initiation fees for 1935, arrears.....	137.25
Installation fees	100.00
Interest on investments.....	907.11
Sale of QUARTERLY.....	1.00
Sale of New York City (1935) bond at.....	200.00
Sale of New York City (1936) bond at.....	200.00
Sale of Consolidated Gas of New York 5½% (1945) bond at	1,050.89
Semi-centennial Fund	13,549.63
	<hr/>
	\$37,181.58

DISBURSEMENTS

Secretary's office (total, \$6,171.63)	
Assistants	\$ 3,483.40
Office, supplies, stamps, etc.....	888.23
Secretary's stipend	1,800.00
Treasurer's office (total, \$174.65)	
Assistant	150.00
Auditing 1935 books.....	10.00
Postage, etc.	14.65
Officers' travelling expenses.....	869.67
QUARTERLY (four issues).....	2,490.48
Engrossing charters	91.60
Special Semi-centennial expenses.....	4,536.03
2 Southern California Edison 3¾% (1960) bonds at.....	2,130.00
2 Consumers Power 3¾% (1965) bonds at.....	2,115.00
2 Edison Elec. & Illum. 3½% (1965) bonds at.....	2,142.50
3 General Motors Acceptance 3% (1946) bonds at.....	3,082.50
3 Consolidated Edison 3¾% (1946) bonds at.....	3,142.50
3 U. S. Treasury 3½% (1949/46) bonds at.....	3,207.19
Accrued interest on above bonds.....	140.89
Loaned to Alumni Fund.....	1,547.48
	<hr/>
	\$31,842.12
Cash on hand, December 31, 1936.....	5,339.46
	<hr/>
	\$37,181.58

ALUMNI FUND

RECEIPTS

Cash on hand, December 31, 1935.....	\$ 000.00
Receipts from subscriptions.....	3.00
Refund from grant-in-aid of research.....	81.15
Interest	90.00
Borrowed from General Fund.....	1,547.48
	<hr/> \$ 1,721.63

DISBURSEMENTS

Research:

Everett Thatcher (1935-36).....	\$150.00
Thomas Smith (1935-36).....	50.00
N. W. Cummings (1935-36).....	41.63
T. T. Chen (1936-37).....	150.00
Donald B. Lawrence (1936-37).....	300.00
Calvin S. Hall (1936-37).....	200.00
Donald H. Menzel (1936-37).....	150.00
C. W. Buggs (1936-37).....	150.00
Hubert M. James (1936-37).....	230.00
George W. Hunter III (1936-37).....	300.00
	<hr/> \$ 1,721.63

Cash on hand, December 31, 1936	000.00
	<hr/> \$ 1,721.63

INVESTMENT ACCOUNT—ALUMNI FUND

(Securities carried at cost)

\$1,000 Southern Pacific Co. 4½% (1969) bond at.....	\$ 905.75
\$1,000 Southern Pacific Co. 4½% (1969) bond at.....	907.00
	<hr/> \$ 1,812.75

GEORGE B. PEGRAM, *Treasurer.*

December 31, 1936.

INVESTMENT ACCOUNT—GENERAL

(Securities carried at cost)

All companies continue to pay interest on their bonds except the St. Louis and San Francisco Railway, which is in receivership.

\$1,000 Amer. Tel. & Tel. Co. 5½% (1943) bond at.....	\$ 991.94
\$1,000 St. Louis & San Francisco Railway 4% (1950) bond (certificate of deposit)	796.35
\$1,000 Baltimore & Ohio Railway 5% (2000) bond at.....	955.00
\$1,000 Philadelphia Company 5% (1967) bond at.....	979.50
\$1,000 Erie Railroad Company 5% (1967) bond at.....	947.00
\$1,000 Southern Railway Company 6% (1956) bond at.....	1,152.00

REPORT OF THE TREASURER

47

\$1,000 Philadelphia Company 5% (1967) bond at.....	997.00
\$1,000 Canadian Pacific 5% (1954) bond at.....	1,010.00
\$1,000 U. S. Treasury 4% (1954) bond at.....	999.06
\$1,000 U. S. Treasury 3% (1955) bond at.....	942.50
\$1,000 U. S. Treasury 3% (1955) bond at.....	942.50
\$1,000 U. S. Treasury 3% (1955) bond at.....	942.50
\$1,000 U. S. Treasury 2½% (1939) bond at.....	1,019.37½
\$1,000 U. S. Treasury 2½% (1939) bond at.....	1,019.37½
\$1,000 U. S. Treasury 2½% (1939) bond at.....	1,019.37½
\$1,000 U. S. Treasury 2½% (1939) bond at.....	1,019.37½
\$1,000 U. S. Treasury 2½% (1939) bond at.....	1,019.37½
\$1,000 U. S. Treasury 2½% (1939) bond at.....	1,019.37½
\$200 New York City (1937) bond at.....	198.50
\$200 New York City (1938) bond at.....	198.50
\$200 New York City (1939) bond at.....	198.50
\$200 New York City (1940) bond at.....	198.50
\$200 New York City (1941) bond at.....	198.50
\$200 New York City (1942) bond at.....	198.50
\$200 New York City (1943) bond at.....	198.50
\$1,000 U. S. Treasury 3% (1938) bond at.....	1,034.03
\$1,000 U. S. Treasury 3% (1938) bond at.....	1,034.03
\$1,000 U. S. Treasury 3% (1938) bond at.....	1,034.03
\$1,000 Southern California Edison Co. 3¾% (1960) bond.....	1,065.00
\$1,000 Southern California Edison Co. 3¾% (1960) bond.....	1,065.00
\$1,000 Consumers Power Co. 3½% (1965) bond at.....	1,057.50
\$1,000 Consumers Power Co. 3½% (1965) bond at.....	1,057.50
\$1,000 Edison Elec. & Illum. Co. 3½% (1965) bond at.....	1,071.25
\$1,000 Edison Elec. & Illum. Co. 3½% (1965) bond at.....	1,071.25
\$1,000 General Motors Acceptance Co. 3% (1946) bond at.....	1,027.50
\$1,000 General Motors Acceptance Co. 3% (1946) bond at.....	1,027.50
\$1,000 General Motors Acceptance Co. 3% (1946) bond at.....	1,027.50
\$1,000 Consolidated Edison Co. 3¼% (1946) bond at.....	1,047.50
\$1,000 Consolidated Edison Co. 3¼% (1946) bond at.....	1,047.50
\$1,000 Consolidated Edison Co. 3¼% (1946) bond at.....	1,047.50
\$1,000 U. S. Treasury 3½% (1949/46) bond at.....	1,069.06½
\$1,000 U. S. Treasury 3½% (1949/46) bond at.....	1,069.06½
\$1,000 U. S. Treasury 3½% (1949/46) bond at.....	1,069.06½
<hr/>	
	\$38,082.88

We have audited the accounts of the Treasurer of the Society of Sigma Xi for the year ending December 31, 1936, and certify that the income shown by the books of the Treasurer has been duly accounted for, that payments have been properly vouched and that the balance sheet and accounts submitted contain a true statement of the financial condition of the Society. We have also examined the securities in the hands of the Treasurer and find the following bonds: \$1,000 Amer. Tel. & Tel Co.; \$1,000 St. Louis & San Francisco Rail-

REPORT OF COMMITTEE ON LECTURES AND PUBLICATIONS

The committee met at Cambridge, Massachusetts, on September 8, 1936, to discuss subjects and speakers for the proposed series of lectures to be presented before Sigma Xi chapters, and to arrange the working conditions of the plan.

Preliminary correspondence with chapter secretaries indicated that about thirty chapters would probably request one or more lecturers from this list during the second semester of the current year.

The general subject of the lectures for 1936-37 is "Frontiers of Science." The lecturers and their subjects are the following:

- E. O. Lawrence, University of California, "Atoms, New and Old."
- H. C. Urey, Columbia University, "The Application of Physical and Chemical Methods to the Problem of the Separation of Isotopes."
- T. S. Painter, University of Texas, "Recent Developments in Our Knowledge of Chromosome Structure and Their Bearing on Genetics."
- Edgar Allen, Yale University, "Internal Secretions in Reproduction."
- L. O. Kunkel, Rockefeller Institute, "New Views in Virus Disease Research."

The working conditions of the plan are the following:

- (1) Each lecturer will specify a period of two weeks during which his lecture will be scheduled. The lectures will be scheduled in a single continuous tour within this period.
- (2) A list of the lecturers with their subjects and dates will be sent to all chapters on January 20. Chapters may request any one or more of the lectures. An honorarium of \$50 per lecture will be paid by each chapter, which will be responsible also for the cost of local entertainment.
- (3) The lectures are available under the conditions here stated for programs financed wholly or partly by other organizations, if the lecture is presented under joint auspices of the Sigma Xi chapter.
- (4) The National Secretary will arrange itineraries, subject to the approval of the lecturers concerned. He will carry on all necessary correspondence with the chapters and will collect the honoraria and other costs. He will pay to each lecturer on completion of his tour the total of all honoraria due and all travel expense.
- (5) Requests for speakers must reach the National Secretary, Dean Edward Ellery, Union College, Schenectady, New York, on or before February 12, 1937.

The committee is now investigating the feasibility of publication of the lectures in book form.

L. J. STADLER, *Chairman.*

SCHEDULE OF THE SIGMA XI LECTURERS FOR 1936

PROFESSOR LAWRENCE:

Virginia Polytechnic Institute, Blacksburg, Va.....	May 6
University of Virginia, Charlottesville, Va.....	May 7
West Virginia University, Morgantown, W. Va.....	May 8
University of Cincinnati, Cincinnati, Ohio.....	May 10
Western Reserve University, Cleveland, Ohio.....	May 11
Mayo Foundation, Rochester, Minn.....	May 13
University of Idaho, Moscow, Idaho.....	May 17
Oregon State College, Corvallis, Ore.....	May 18

PROFESSOR UREY:

University of Oklahoma, Norman, Okla.....	April 12
Kansas State College, Manhattan, Kan.....	April 13
Indiana University, Bloomington, Ind.....	April 15
Swarthmore College, Swarthmore, Pa.....	April 20

PROFESSOR KUNKEL:

Stanford University, Calif.....	June 1
University of Colorado, Boulder, Colo.....	June 4
University of Missouri, Columbia, Mo.....	June 8

PROFESSOR PAINTER:

Swarthmore College, Swarthmore, Pa.....	March 16
Brown University, Providence, R. I.....	March 19
Michigan State College, East Lansing, Mich.....	March 22
University of Missouri, Columbia, Mo.....	March 24
University of Arkansas, Fayetteville, Ark.....	March 26
Louisiana State College, Baton Rouge, La.....	March 29

PROFESSOR ALLEN:

Tulane University, New Orleans, La.....	March 31
University of Alabama, University, Ala.....	April 3
Virginia Polytechnic Institute, Blacksburg, Va.....	April 5
University of Maine, Orono, Me.....	April 8

INSTALLATION OF THE GEORGE WASHINGTON CHAPTER

A brilliant and impressive ceremony of installation of the George Washington Chapter of the Society of the Sigma Xi formed a prominent part of the mid-winter Convocation of the one hundred and sixteenth year of the George Washington University, February 22, 1937. Dean Pegram, National Treasurer, and Professor Ellery, National Secretary, presided at an afternoon meeting at the Cosmos Club, which was attended by an audience of several hundred members and associates of the Society, composed of the petitioning group, of representatives from thirty-one of the sixty-eight chapters, and of many alumni members and associates resident in Washington. The chapter constitution and by-laws were adopted and officers were elected as follows:

President, Paul Bartsch.

Vice-President, Leland W. Parr.

Secretary-Treasurer, Paul W. Bowman.

At this gathering President Marvin, two trustees of the university, some of the faculty and a few graduate students were inducted into the Society as members by Dean Pegram, and a few undergraduates as associates.

The university convocation and formal ceremony of installation took place in Constitution Hall. The address was given by William Alanson White, the noted psychiatrist, on the topic "The Function of Education as Viewed from the Standpoint of the Present World Crisis." (The address is given in full, page 20, this issue of the *QUARTERLY*.) The charter of the George Washington Chapter was presented by Secretary Ellery and the charge to the chapter was given by Treasurer Pegram.

President Marvin, acting on the authority of the trustees of the university, took the occasion of the convocation and installation to confer honorary degrees on eight men of science as follows (the citations are those read by Doctor Marvin):

CHARLES GREELEY ABBOTT

(Doctor of Science)

Persistent and courageous investigator in the field of astrophysics, in whom scientific thinking and religious reflections are not separated; secretary of the Smithsonian Institution.

PAUL BARTSCH (Curator, Division of Mollusks, U. S. National Museum)
(Doctor of Science)

Eager scientist; teacher; quick to appreciate human values; who for years has devotedly served in the George Washington University.

WILLIAM BOWIE (Director, Division of Geodesy, U. S. Coast and Geodetic Survey)
(Doctor of Science)

Graduate of Trinity College (Connecticut); cheerful colleague; and tried friend of those who seek for truth; to whom long experience in scientific endeavor has brought recognized leadership.

LYMAN JAMES BRIGGS

(Doctor of Science)

Sincere scholar and worthy public servant, in whom firmness of conviction and tolerance toward the beliefs of others go hand in hand; chosen to direct the Bureau of Standards.

GEORGE BRAXTON PEGRAM

(Doctor of Science)

Son of the South; well-known investigator and expounder of physical sciences; worthy servant of Columbia University; National Treasurer of the Society of the Sigma Xi.

EDWARD ELLERY

(Doctor of Laws)

Teacher, administrator and man of science, skillful in encouraging scientific endeavor; National Secretary of the Society of the Sigma Xi.

JOHN CAMPBELL MERRIAM

(Doctor of Laws)

Master in the field of paleontology, painstaking leader in scientific investigation, philosopher, and man of letters; devoted to the principles of natural law and fully cognizant of their application in the life of today; president of the Carnegie Institute of Washington.

WILLIAM ALANSON WHITE (Superintendent, St. Elizabeth's Hospital)

(Doctor of Laws)

Productive scholar, devoted teacher, enlightened executive, able to make knowledge a saving power in the lives of men; to know him is to desire his friendship.

CHAPTER OFFICERS

List Furnished by the Secretaries of the Chapters

CHAPTER	PRESIDENT	VICE-PRESIDENT	SECRETARY	TREASURER
	A. R. Mann.....	B. F. Kingsbury.....	L. F. Randolph.....	A. J. Heinicke
	F. M. Sebast.....	J. B. Cloke.....	J. D. Kinney.....	H. E. Stevens
	E. S. C. Smith.....	V. Rojansky.....	F. J. Studer.....	R. W. Abbott
	N. P. Sherwood.....	W. C. McNowen.....	W. H. Schoewe.....	H. E. Jordan
	E. O. Waters.....	A. F. Kovarik.....	L. S. Stone.....	H. J. Lutz
	W. H. Emmons.....	W. L. Hart.....	R. E. Montonna.....	J. Valasek
	H. J. Kesner.....	H. W. Manter.....	E. N. Andersen.....	M. G. Gaba
	E. Van Cleef.....	J. H. Gourley.....	F. A. Hitchcock.....	F. A. Hitchcock
	H. S. Lukens.....	J. L. T. Appleton.....	E. R. Helwig.....	J. M. Fogg
	H. E. Walter.....	C. W. Miller.....	P. H. Mitchell.....	W. E. Benford
	A. C. Tester.....	J. D. Boyd.....	Beth L. Wellman.....	A. T. Craig
	P. H. Kirkpatrick.....	S. B. Morris.....	E. L. Grant.....	E. L. Grant
	C. W. Porter.....	L. C. Uren.....	R. L. Olson.....	H. E. White
	M. T. Bogert.....	H. W. Webb.....	A. W. Thomas.....	A. W. Thomas
	G. A. Bliss.....	D. B. Phemister.....	F. C. Bucy.....	R. G. Sanger
	C. V. Weller.....	H. H. Higbie.....	R. G. Smith.....	R. K. McAlpine
	C. L. Metcalf.....	W. L. Schulz.....	E. G. Young.....	D. T. Enslis
	J. R. Martin.....	G. L. Tuve.....	R. L. Burlington.....	T. M. Focke
	J. J. Galloway.....	G. S. Snoddy.....	R. J. Hartman.....	W. D. Thornbury
	A. E. Stearn.....	C. W. Turner.....	G. F. Brockridge.....	Dorothy Nightingale
	H. B. Van Valkenburgh	J. J. Waring.....	Hugo Rodeck.....	W. K. Nelson
		R. M. Hill.....		
	C. D. Hurd.....	C. A. Dragstedt.....	R. A. Fisher.....	A. L. Howland
	V. A. Young.....	J. M. Robeson.....	C. C. Spencer.....	Mildred Faust
	O. L. Kowalke.....	H. W. Mossman.....	C. A. Richards.....	W. E. Roseveare
	W. L. Beuschlein.....	B. L. Grondal.....	D. H. Loughridge.....	T. S. Jacobson
	H. A. Maxfield.....	R. A. Beth.....	W. E. Lawton.....	H. B. Feldman
	C. B. Jordan.....	M. G. Mellon.....	S. M. Hauge.....	H. L. Solberg
	L. McMaster.....	J. P. Nafe.....	C. Tolman.....	A. S. Gilson
	Wm. Bowie.....	F. V. Coville.....	O. S. Adams.....	Wm. Lerch
	R. H. Cuyler.....	H. R. Henze.....	H. F. Rosene.....	P. M. Batchelder
	G. M. Higgins.....	J. L. Bollman.....	E. V. Allen.....	E. V. Allen
	A. Henderson.....	E. Bagby.....	R. W. Bost.....	R. W. Bost
	C. W. Telford.....	H. E. French.....	A. R. Oliver.....	A. R. Oliver
		Rachel Edgar.....	J. M. Aikman.....	W. J. Schlick
	H. J. Gilkey.....	I. D. Garard.....	H. Johnson.....	E. P. Starke
	A. A. Boyden.....	B. P. Babkin.....	R. D. Gibbs.....	R. L. Kutz
	J. B. Collip.....	C. V. Christie.....		
		O. J. Stewart.....	M. M. White.....	A. Brauer
	S. E. Erickson.....	L. H. Stauffer.....	E. C. Jahn.....	J. B. Reed
	V. Cherrington.....	H. Brinkmann.....	H. J. Creighton.....	H. J. Creighton
	S. B. Lilly.....	E. S. West.....	C. Hall.....	A. Moursund
	W. D. Smith.....	J. H. Yoe.....	J. K. Roberts.....	J. K. Roberts
	S. A. Mitchell.....	J. H. Gregory.....	M. W. Pullen.....	M. W. Pullen
	W. M. Clark.....			
		P. W. Merrill.....	A. O. Beckman.....	E. E. Sechler
	J. P. Buwalda.....	G. B. Wallace.....	D. Ludwig.....	D. Ludwig
	A. E. Hill.....	J. H. Hoskins.....	S. B. Arenson.....	S. B. Arenson
	C. N. Moore.....	V. G. Grove.....	R. Hutson.....	L. N. Field
	S. G. Bergquist.....	H. C. Schwalen.....	R. E. Heineman.....	R. E. Heineman
	R. F. Graesser.....	C. H. Sutherland.....	H. A. Neville.....	A. Butts
	J. B. Reynolds.....	W. B. Kemp.....	C. E. White.....	C. E. White
	A. L. Schrader.....	Martha Kramer.....	H. H. Laude.....	J. L. Hall
	R. K. Nabours.....			
		O. Bergeim.....	W. H. Welker.....	I. Pilot
	E. Oldberg.....	H. A. Everett.....	A. K. Anderson.....	T. B. Keith
	G. C. Chandlee.....	M. D. Wilson.....	L. E. Harris.....	L. E. Harris
	F. E. Clements.....	H. H. Langdon.....	J. Sotola.....	J. Sotola
	C. C. Prouty.....	R. H. Bruce.....	H. D. Thomas.....	C. L. Porter
	O. A. Beath.....	T. R. Wilkins.....	Q. D. Singewald.....	Q. D. Singewald
	W. S. McCann.....	J. S. Taylor.....	G. M. McKinley.....	W. H. Emig
	C. G. King.....	E. J. Cohn.....	F. M. Carpenter.....	J. P. DenHartog
	E. G. Boring.....	W. G. Simon.....	E. Muntwyler.....	F. Hovorka
	C. J. Wiggers.....	N. H. Furman.....	L. A. Turner.....	E. Dorf
	C. Ten Broeck.....	F. Bernheim.....	H. J. Oosting.....	Bert Cunningham
	W. C. Vosburgh.....			
		A. W. Bellamy.....	H. C. Gilhausen.....	A. H. Warner
	G. E. F. Sherwood..	G. R. Harrison.....	J. B. Wilbur.....	B. E. Proctor
		W. T. Penfound.....	H. N. Gould.....	H. N. Gould
	J. W. M. Bunker....	H. B. Goodrich.....	C. L. Stearns.....	C. L. Stearns
	W. B. Gregory.....	N. H. McCoy.....	Geo. Olds Cooper.....	Elizabeth S. Hobbs
	M. C. Foster.....	C. H. Gingrich.....	M. B. White.....	N. S. Dungay
	Glady A. Anslow.....	A. R. Shadle.....	R. R. Humphrey.....	C. F. Scofield
	F. F. Exner.....		W. D. Langley.....	
	W. J. Atwell.....		P. W. Bowman.....	P. W. Bowman
		L. W. Parr.....		
	P. Bartsch.....			

SIGMA XI CLUBS

CLUB	PRESIDENT	VICE-PRESIDENT	SECRETARY	Treasurer
Southern California	R. W. Truesdail.....	.....	J. A. Hartley.....	J. A. Hartley.....
University of Denver	T. R. Garth.....	.....	E. A. Engle.....	E. A. Engle.....
Oregon State Agricul. College... ..	W. E. Milne.....	B. T. Simms.....	H. A. Scullen.....	H. A. Scullen.....
West Virginia University	W. A. Koehler.....	S. Morris.....	O. R. Ford.....	O. R. Ford.....
University of Maine	W. F. Dove.....	M. Freeman.....	M. D. Sweetman....	M. D. Sweetman....
University of Florida	R. C. Williamson... ..	W. R. Carroll.....	P. A. Foote.....	P. A. Foote.....
Colorado Agricul. College	L. W. Durrell.....	F. P. Goeder.....	D. Gunder.....	D. Gunder.....
Louisiana State University	E. C. Timms.....	A. D. McKinley....	W. Whitcomb.....	W. Whitcomb.....
University of Alabama	F. S. Dubois.....	Anna Church.....	J. D. Mancil.....	K. Coons.....
University of Arkansas	W. M. Roberds.....	.....	L. B. Ham.....	L. B. Ham.....
University of Calif. at Davis... ..	F. N. Briggs.....	.....	N. E. Edlefsen.....	N. E. Edlefsen.....
University of Utah	F. F. Hintze.....	T. J. Parmley.....	Margaret Schell....	Margaret Schell....
Clark University	W. W. Atwood.....	.....	P. M. Roope.....	P. M. Roope.....
St. Louis University	F. E. Poindexter....	E. A. Daisy.....	L. F. Yntema.....	.....
Connecticut State College	W. F. Cheney, Jr....	E. L. Kelly.....	C. H. W. Sedgewick..	C. H. W. Sedgewick..
Miami University	W. H. Shideler.....	.....	R. V. Van Tassel....	R. V. Van Tassel....
University of Georgia	A. S. Edwards.....	.....	J. W. Nuttycombe... ..	B. J. Miller.....
Bucknell University	W. H. Eyster.....	.....	B. J. Miller.....	.....
Oklahoma A. and M. College	W. V. N. Garretson..	F. M. Durbin.....	J. E. Webster.....	J. E. Webster.....
Montana State College	D. B. Swingle.....	H. T. Ward.....	P. L. Copeland.....	P. L. Copeland.....
North Dakota Agr. College	L. M. Roderick.....	H. H. Flor.....	H. E. Wirth.....	H. E. Wirth.....
Texas Tech. College	R. A. Studhalter....	H. F. Godeke.....	W. M. Craig.....	.....
University of Montana	F. O. Smith.....	G. D. Shallenberger..	C. W. Waters.....	.....
Virginia Polytechnic Inst.	S. A. Wingard.....	.....	W. L. Threlkeld.....	.....
Peking, China	C. W. Luh.....	C. M. Van Allen....	A. P. T. Sah.....	A. P. T. Sah.....
Wichita	W. A. Ver Wiebe....	C. C. McDonald.....	E. A. Marten.....	E. A. Marten.....
Massachusetts State College	W. H. Davis.....	F. J. Sievers.....	C. R. Fellers.....	C. R. Fellers.....
Ohio University.....	R. L. Morton.....	A. C. Anderson.....	E. H. Gaylord.....	E. H. Gaylord.....
University of New Mexico.....	S. A. Northrop.....	E. F. Smellie.....	R. E. Holzer.....	R. E. Holzer.....
Kansas City	R. G. Stone.....	J. E. Wildish.....	L. Misbach.....	L. Misbach.....
Polytechnic Institute of Brooklyn.....	R. E. Kirk.....	C. C. Whipple.....	W. H. Gardner.....	W. H. Gardner.....
Marquette University	H. P. Pettit.....	D. R. Swindle.....	J. F. H. Douglas....
Milwaukee	Mary Pinney.....	M. J. Martin.....
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